

**LOUISIANA
WILDLIFE
AND
FISHERIES
COMMISSION**

**EIGHTH
BIENNIAL
REPORT
1958-1959**



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Louisiana
Wild Life and
Fisheries Commission
1958-1959

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R. P. EASTERLY
DIRECTOR

State of Louisiana

WILD LIFE AND FISHERIES COMMISSION
400 ROYAL STREET
NEW ORLEANS 16

May 1, 1960

TO THE GOVERNOR AND MEMBERS OF THE
LOUISIANA LEGISLATURE

Gentlemen:

Accompanying this letter is the Biennial Report of the activities of the Louisiana Wild Life and Fisheries Commission covering the calendar years ending December 31, 1958 and December 31, 1959.

It is with a sincere sense of pride that the Commission submits this report of its activities and accomplishments. Progress in wildlife conservation is evident and the people of Louisiana are reaping benefits from this program of work.

Respectfully submitted,

A handwritten signature in cursive script, appearing to read "R. P. Easterly".

R. P. Easterly,
Director.

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ADMINISTRATION DIVISION

RUDOLPH P. EASTERLY
Director

WE ARE PROUD to report that the past biennium has been one of progress for the Louisiana Wild Life and Fisheries Commission and that we have been successful in carrying out most of our programs and those of the men who preceded us and that we have great plans for the future.

It has been estimated that upwards of three million dollars will be needed over the next few years for acquisition of additional game management and public shooting areas in our state.

The State of Louisiana is not alone in this need for lands for recreational purposes for this is a problem which also confronts many other states in our country. The explosive human populations in the United States and the ever-increasing trend of urban expansion plus industrial development into rural sections has caused a steady encroachment upon the habitat of our wildlife and our booming populations will be looking for outdoor recreation in the very areas they have invaded by sheer weight of numbers. So now is the time for us to acquire these game management and public shooting areas before the cream of our lands are swallowed up by human expansion and industry.



E. R. McDONALD, SR.



RUDOLPH P. EASTERLY

Moreover, we must continue with the programs now underway in our education and publicity division, on our wildlife refuges, in our fur, oyster water bottoms and seafoods, fish and game, water pollution control and enforcement divisions. Incorporated into most of these divisions of our organizations are sub-divisions, called sections and these, such as the biological section, water hyacinth control section and many others are in the field to gather data and evidence to support many of the commission's conclusions and rulings.

It is for these and many other reasons that our commission is seeking to impress upon the present Legislature the necessity for the funds to carry on our program for it would surely be poor economy to let what we have already done and are doing go by the wayside.

We feel, as does every employee of the commission, that our efforts have been successful mainly because we have had the confidence and support of E. R. McDonald, chairman of the Board of Commissioners and all of its members. Besides being a successful farmer and cattleman, Mr. McDonald is an ardent sportsman and has proved, by his actions in giving his valuable time to the affairs of the commission, that he is a true conservationist. George A. Foster, of Pollock, vice-chairman, who has consecutively been re-appointed from the original commission which came into being in 1952 by constitutional amendment and thus became a separate state agency, has likewise proved his devotion to the wildlife cause and given unstintingly of his time and efforts. And as a matter of fact, one has but to take a glimpse at the record of the success of all of the commissioners to reason why our progress has been steady; John



GEORGE A. FOSTER



JOHN CUTRONE

Cutrone, of Morgan City, has for many years been prominently identified with the fur industry as a buyer and expert on furs and as an owner of extensive fur producing lands; Ray Whatley, of Alexandria, a packing-house owner, one of the best known sportsmen in central Louisiana and an ardent participant in many of our fishing rodeos, has likewise been a great adjunct to the commission for he has brought

with him many of the new and progressive ideas a young and aggressive business man would have; Raleigh Pitre, of Cutoff, is the production of generations of men whose names are written in the history of the Louisiana fisheries industry; James Frey, of Lafayette, is a member of one of the state's oldest and largest packing firms and he too has taken a life-long interest in sports afield and conservation of nat-



JAMES J. FREY



T. MAX McFATTER



RAY WHATLEY



RALEIGH J. PITRE

ural resources.

T. Max McFatter, of Lake Charles, latest appointee to the commission now lending his experience to our organization, is owner of a large sporting goods organization and his intimate and invaluable contacts have already been effective in aiding our programs.

In 1959 the commission lost two of its most esteemed commissioners. With the passing of W. L. Caldwell and Alton M. Holden, both of Baton Rouge, the cause of conservation was dealt a severe blow for both of these gentlemen were not only foremost in their fields of business endeavor, but they also found time to give their services without remuneration to aid the cause of conservation.

When he died, Caldwell was chairman of the Board of the Fidelity, Inc., of Bunkie and of the Avoyelles Trust and Savings Bank and the American Bank and Trust Company at Baton Rouge. Holden was founder and part owner of the Baton Rouge Fabricators and owner of the Louisiana Plumbing and Electric Company.

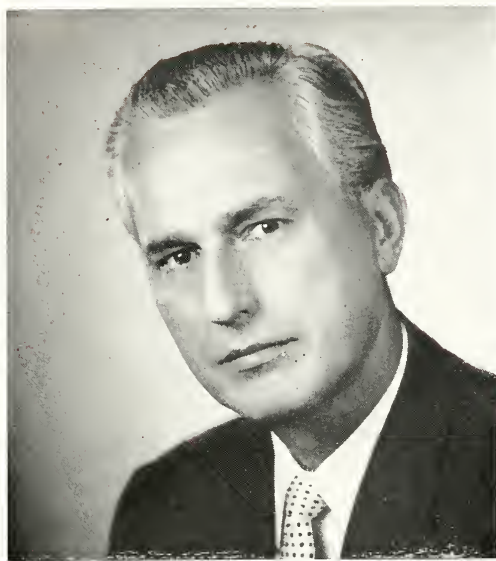
During the past two years the commission has gone ahead with a stepped up program directed towards the improvement of wildlife habitat. This has been effected mainly through game management, water pollution control and restocking of lakes, streams and ponds and scientific research. In the fish and game division a statistical unit was established to assist with the design of research projects and analysis of data gathered. Approximately 100,000 acres of land and water areas were acquired for development into public hunting and fishing grounds.

In keeping with the commission's policy of open public meetings an additional forum was publicized in advance and held to gather the opinions of sportsmen as to how the hunting seasons should be set. The water hyacinth control program was stepped up and successful techniques for rearing of crappie

and channel catfish were devised by our research men. Commercial fishing has been aided immeasurably through research and management by our biologists by such aids as selective total poisoning, selective seining and many other methods.

During the past two years there has been extensive activity towards improvement of our refuges and game management areas. At the Rockefeller Wildlife Refuge, locks, canals and new buildings have been constructed including an office and laboratory. Plans are being prepared for the construction of a 12,000 acre water control area southeast of Deep Lake; refuge personnel has completed repair on all levees damaged by hurricane "Audrey". There are more than one hundred miles of levees in this area. Water wells have been drilled; boundary markers have been replaced around the entire refuge and forty-two walkways to water control structures have been either repaired or replaced; a one-hundred and sixty foot bulkhead of interlocking sheet piling and concrete is nearing completion; through proper management extensive production of millet and widgeon grass has resulted where more than 400,000 ducks and 35,000 blue and snow geese make their stay during the winter and where many more thousands of waterfowl use the refuge during fall and spring migrations; a three thousand foot airstrip for commission use has been partially constructed; intensive research has been conducted by two biologists and a part time geologist which included evaluation of the development projects, the banding of waterfowl, a study of erosion along the canal banks of the refuge and the publication of two research bulletins.

At Marsh Island refuge work has been completed on the re-building of the levees around the 8,000 acre impoundment and waterfowl food plants have been planted; five water control structures around the levee of the impoundment were constructed and



CHARLES LANGE
Executive Assistant

a 750 foot bulkhead around headquarters of the refuge has also been completed; seven Wakefield-type weirs were installed in bayous of the area to stabilize water conditions and boat houses, work shops and camps have been built or improved; all mineral activities have been closely supervised on the refuge to minimize damage and in all there has been a substantial increase of waterfowl wintering in the area over the past two years.

In the Pass-a-Loutre game management area more than one hundred earthen dams have been constructed to increase waterfowl food production in the marshes; nine public camps and the main camp were remodeled on the insides and additional facilities installed, and a total of 1,709 duck hunters participated in the public hunting program during the past two years; a 2900 foot landing strip has been constructed and arrangements have been made to build up the headquarters site by means of a suction dredge and material purchased for new wharfs. Research studies have been conducted with emphasis on the kill of waterfowl. The results will be used in verifying the validity questionnaire-type kill surveys conducted by the United States Fish and Wildlife Service of the Department of the Interior. This work was coordinated through the Mississippi Flyway council.

At the State Wildlife Refuge the aging headquarters camp has been completely remodeled; the boundaries have been entirely re-marked and a complete engineering survey made around the entire boundary; the airstrip was extended 250 feet and the bulkhead around headquarters site received extensive repairs. The usual frequent patrols were made over the area to prevent violations; research studies were conducted by biologists and it is estimated that almost 50,000 waterfowl used the refuge area each year.

The entire boundary of the Coulee Wildlife Refuge in North Louisiana has been surveyed and marked;

additional water control structures were added; successful brown top millet plantings by airplane were made in the lower impoundment; levee repairs were effected as needed and it is estimated that 30,000 ducks used this refuge each winter.

Among the major accomplishments of the Division of Oysters, Waterbottoms and seafoods during the last biennium was its aid in formulating legislation in 1958 which was in a large way responsible for the increase in shrimp production in 1958 and the additional increase in production in 1959. This bill closed waters that were nursery grounds for baby shrimp to trawlers thus allowing the shrimp to mature, double in weight and size, and in market value. After the shrimp bill became a law the division assisted the law enforcement division in its strict enforcement of this remedial legislation.

In the early summer of 1959 the largest shell bedding program in the south was conducted which will result, according to inspection by scientists, in good seed oyster production in September of 1960 and a marketable crop in September of 1961. During the operations, 135,369 barrels were planted in Lake Borgne about a mile north of Petit Pass Island. More than 250,000 barrels of clam shells were planted in Black Bay and an excellent catch on these shells resulted, a survey showed. The entire bay has been closed until 1960 when an excellent catch of seed oysters is assured. The closed area has been marked and is under constant patrol by seafood inspectors and a boat assigned to the area.

Also the Mississippi cannery returned 20 percent of their shells from oysters canned by them and these were planted as "clutch" in Bay Boudreaux and inspection later showed a one hundred percent catch on them.

During 1959 an additional Coastal Waste Control boat, manned by a captain and a Waste Disposal inspector, was placed in operation to assist in controlling pollution in our coastal areas caused by steadily increasing activities by industries. The Division of Oysters, Water Bottoms and Seafoods was assigned the duty of enforcing Stream Control Commission regulations.

The new marine laboratory at Grand Terre is nearing completion at a cost of approximately \$182,000 and the oyster biological staff will be located there. During 1958-59 this group investigated numerous complaints by oystermen who received remuneration for damages which occurred. Demand for damages was based on complete biological data obtained by members of the staff. Also data obtained from the shrimp research program rendered valuable assistance in promulgating the new shrimp law which proved of much value in increasing shrimp production in Louisiana waters. The staff engaged in this work has been increased and this program is being expanded.

This division also worked with the United States Engineers and the Department of Public Works in the selection of the route for the proposed Barataria Bay Waterway so that its construction will do the least damage to oyster industry and its surveyors assisted the Department of Public Works in locating the oyster leases that would be affected and is at present working with the Jefferson Parish Council to see that rights of ways and easements are obtained

by the parish and that the fishermen leasing the oyster beds are compensated.

One of the major accomplishments of the law enforcement division was of course making the shrimp law work, for many were resentful of the closed season and refused to take the orders for a closed season seriously at first. The result was that the enforcement division stepped in and wholesale arrests were made. Patrol boats and planes swept the closed waters and brought the violators to their senses. Now that the Louisiana shrimp crop has made a comeback all are agreed that the closed season was highly beneficial to shrimp production.

The enforcement division has practically eliminated fish shocking in the Atchafalaya River area with a total of 61 cases of arrests. This was done by employing faster and larger boats to run down the mal-factors.

The sale of game fish has been cut to a minimum and the enforcement division scored a record arrest with the confiscation of 800 pounds of game fish from an establishment in Baton Rouge; also in co-operation with federal agents the division participated in one of the largest seizures of migratory waterfowl in recent years totalling 376 birds.

A major accomplishment during the past biennium was obtaining occupancy of the entire building at 400 Royal street in New Orleans which was purchased from the city and had been occupied by city and state agencies. This afforded the various divisions much needed office space.

The Accounting Section has been moved to a single room of adequate size with an outside entrance and counters have been installed to serve the public, also the old Supreme Court Chamber has been renovated and all the commission meetings at headquarters are held in it.

The ground floor of the building has been com-

pletely renovated and the Division of Education and Publicity is now moving the wildlife museum from the old Presbytere to the front section of the building facing Royal street where it will be housed and be accessible to the thousands of tourists who pass before its door each day.

During 1958-59 the Division of Water Pollution control has continued in its policy of maintaining and/or upgrading the water quality of the state's streams. Division personnel have been active in investigating stream conditions; are conducting a water quality survey of thirty important streams in the state and is also conducting a chemical and biological survey of the Mississippi river. The division is continuing in its efforts to abate pollution from sugar factory waste discharge, investigate fish mortalities, the effects of the use of pesticides, oil field brine and the like and is completing a state-wide survey of industrial water usages.

During the past biennium the Fur Division has succeeded in a campaign to promote the use of nutria carcasses in the manufacture of mink and pet foods thus augmenting the trapper's income. It has likewise induced the eastern furriers in a campaign to popularize nutria among women of college age and promotional advertising campaigns are underway to put the furs on the market as a top quality style item.

The Division of Education and Publicity is continuing in its stepped up work among the school children and its magazine, the LOUISIANA CONSERVATIONIST, whose circulation has mounted to 65,000 unsolicited subscriptions, from 45,000 two years ago, continues to grow in popularity and prestige.

These things are by no means all that has been done by the Wild Life and Fisheries Commission, but are merely highlights and a more extensive and detailed account may be found elsewhere within the covers of this book.

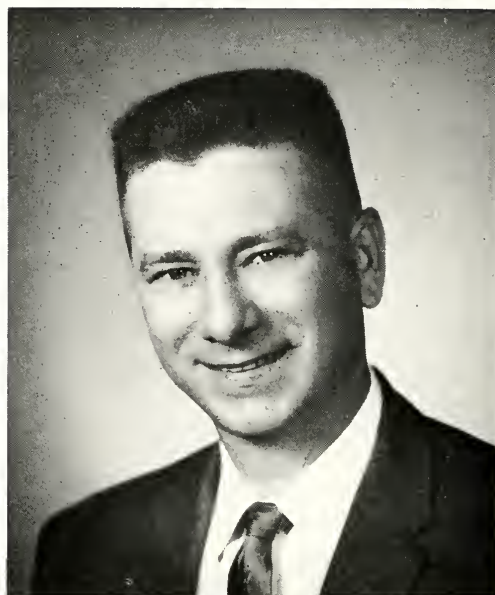
ACCOUNTING SECTION

ROY SCHAEFER

Chief Accountant

THE ACCOUNTING SECTION is in charge of the operating funds for the commission, which are appropriated by the legislature from the Conservation Fund, which in turn derives its revenues from sales of hunting, fishing, and commercial fishing and trapping licenses, oil leases and royalty revenues, sulphur severance taxes and other miscellaneous taxes.

The duties of the Accounting Section are to maintain all records and collect all revenues; to gather financial, statistical, purchasing, payroll, and budgetary reports; make field audits, and to handle the payment of all invoices.



ROY SCHAEFER

ACCOUNTING

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ROGER HUNTER
Revenue Supervisor

EXHIBIT 1.

OPERATING REVENUE RECEIPTS ACTUAL RECEIPTS 1958-59 ESTIMATED RECEIPTS 1959-60

Type of Revenue	Actual 1958-59	Estimated 1959-60
Sport Licenses:		
Angling—New Orleans	\$ 31,226.00	\$ 31,000.00
Angling—Other Parishes	202,809.62	204,000.00
Total Angling	\$ 234,035.62	\$ 235,000.00
Hunting—New Orleans	\$ 18,434.00	\$ 18,000.00
Hunting—Other Parishes	258,042.68	259,000.00
Total Hunting	\$ 276,476.68	\$ 277,000.00
Total Sport Licenses	\$ 510,512.30	\$ 512,000.00

Commercial Fishing & Dealers:

(Includes Fish, Shrimp & Oyster)		
Commercial Fisherman	\$ 4,965.00	\$ 5,000.00
Hoop Net	9,395.00	9,500.00
Fresh Water Seine	1,695.00	1,700.00
Fresh Water Trammel Net.....	5,420.00	5,500.00
Fresh Water Gill Net.....	15,530.00	16,000.00
Salt Water Fish & Shrimp Seine	830.00	800.00
Salt Water Trammel Net.....	1,895.00	1,800.00
Salt Water Menhaden Seine		
& Vessel	8,400.00	8,500.00
Oyster Vessel Tonnage	1,273.50	1,300.00
Oyster Dredging	8,100.00	8,100.00
Salt Water Fish Vessel.....	15,815.00	2,000.00
Salt Water Shrimp Trawl		
& Vessel	135,400.00	104,000.00
Salt Water Shrimp Freight	790.00	700.00
Oyster Bedding Ground	52,141.00	52,000.00
Oyster Shop & Resale.....	985.00	1,000.00
Wholesale Dealer	13,750.00	14,000.00
Wholesale Dealer's Agent	1,020.00	1,000.00
Retail Dealer	17,850.00	18,000.00
Total Com'l Fishing & Dealers	\$ 295,254.50	\$ 250,900.00

Severance Tax:

Gravel	\$ 6,944.25	\$ 7,000.00
Sand & Fill Materials.....	37,839.89	38,000.00
Fur	35,287.70	35,000.00
Oyster	12,917.21	13,000.00
Shrimp	35,646.00	45,000.00
Total Severance Tax.....	\$ 128,635.05	\$ 138,000.00

Miscellaneous Licenses & Receipts:

Hunting Club	\$ 1,070.00	\$ 1,000.00
Hunting Preserve	600.00	600.00
Game Breeder	880.00	1,000.00
Oyster Transfer of Lease.....	35.00	40.00
Resident Fur Buyer.....	3,100.00	3,100.00
Resident Fur Dealer	2,700.00	2,700.00
Non-Res. Fur Dealer	900.00	900.00
Trapper—New Orleans	382.00	400.00
Trapper—Other Parishes	6,914.77	6,600.00
Total Misc. Licenses		
& Receipts	\$ 16,581.77	\$ 16,340.00

Royalties from Mineral Leases:

Oil & Gas	\$ 658,960.42	\$ 655,000.00
Sulphur	348,354.84	350,000.00
Total Royalties	\$1,007,315.26	\$1,005,000.00

TOTAL OPERATING

REVENUE	\$1,958,298.88	\$1,922,240.00
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EXHIBIT 1

OPERATING ACCOUNT

Means of Financing	Actual 1958-59	Estimated 1959-60
State Appropriation	\$1,897,306	\$2,024,758
Federal Appropriation		
Water Pollution	42,447	40,000
Total Appropriation	1,939,753	2,064,758
Total Expenditures	1,890,489	2,064,758
Refund to State Treasurer	49,264	

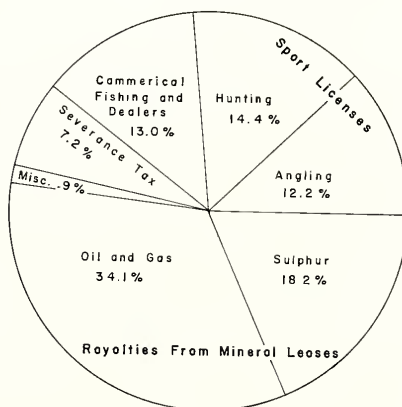
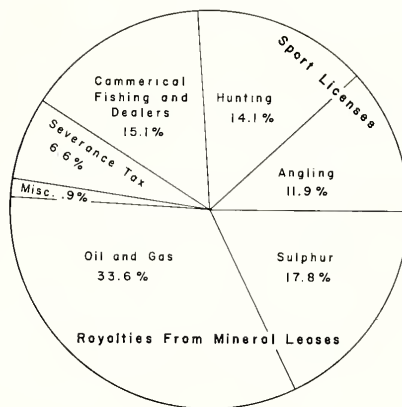
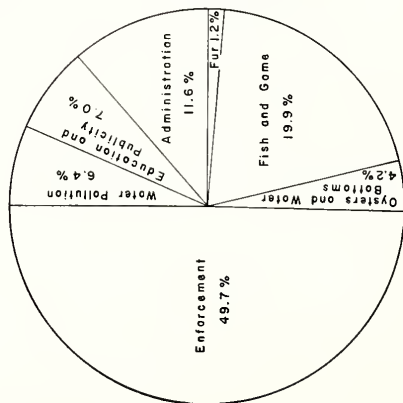


EXHIBIT 2

OPERATING ACCOUNT BY DIVISIONS ACTUAL EXPENSES FOR THE FISCAL YEAR 1958-1959

Class of Expenditures	Administration	Education & Publicity	Water Pollution	Enforcement	Oyster & Water Bottoms	Fish & Game	Fur & Refuge	Total Operating
Salaries	200,889	42,762	70,705	637,975	55,370	239,680	17,880	1,265,261
Contractual Services	99,532	81,436	4,444	58,087	3,525	33,365	1,802	282,191
Traveling Expenses	16,383	1,620	7,618	157,584	2,805	38,606	1,476	226,092
Material & Supplies	46,314	5,438	10,752	69,212	15,507	60,086	1,420	208,729
Special Current Charges	80,784	.....	.....	.....	.....	.....	.....	80,784
Equipment-Capital Outlay	10,576	199	27,514	17,846	1,253	5,152	.....	62,540
Total Expenditures	454,478	131,455	121,033	940,704	78,460	376,889	22,578	2,125,597
Less: Airplanes, Wharf & Adm. Credits	(235,108)	.....	.....	.....	.....	.....	.....	(235,108)
TOTAL NET EXPENDITURES	219,370	131,455	121,033	940,704	78,460	376,889	22,578	1,890,489



ESTIMATED EXPENSES FOR THE FISCAL YEAR 1959-1960

Class of Expenditures	Administration	Education & Publicity	Water Pollution	Enforcement	Oyster & Water Bottoms	Fish & Game	Fur & Refuge	Total Operating
Salaries	218,905	36,945	78,015	636,355	54,115	227,400	17,100	1,268,835
Contractual Services	92,866	83,445	4,565	65,980	3,600	42,550	1,102	294,108
Traveling Expenses	9,129	850	9,600	159,766	3,700	42,000	1,260	226,305
Material & Supplies	42,087	6,250	11,500	77,495	15,696	75,282	900	229,210
Special Current Charges	81,826	.....	.....	.....	.....	.....	.....	81,826
Equipment-Capital Outlay	3,982	2,363	9,640	42,407	.....	.....	.....	104,320
Major Repairs .....	.....	.....	.....	.....	10,000	50,000	.....	60,000
Total Expenditures	448,795	129,853	113,320	982,003	87,111	483,260	20,362	2,264,704
Less: Airplanes, Wharf & Adm. Credits	(199,946)	.....	.....	.....	.....	.....	.....	(199,946)
TOTAL NET EXPENDITURES	248,849	129,853	113,320	982,003	87,111	483,260	20,362	2,064,758

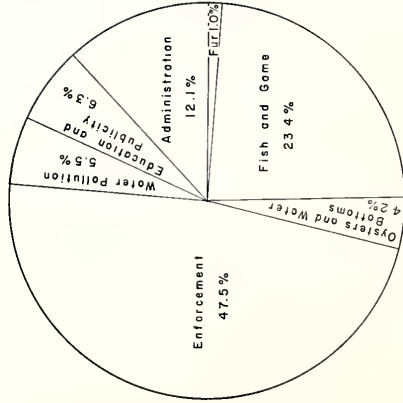


EXHIBIT 3

PITTMAN-ROBERTSON ACCOUNT

<i>Means of Financing</i>	<i>Actual 1958-59</i>	<i>Estimated 1959-60</i>
Federal's Share of Expenditures	\$ 269,029	\$ 375,164
State's Share of Expenditures	89,676	125,054
Total	<u>358,705</u>	<u>500,218</u>
Analysis of Expenditures:		
Management coordination—the administration and supervision by technically trained personnel of all Federal Aid Projects.....	27,667	35,200
Investigation of wildlife to promote sound management practices.....	105,752	116,689
Development & operation of game management areas to increase the game species	166,598	248,000
Statistical Analysis of Game and Fish research data		14,889
Wisner Waterfowl development	51,801	68,727
Biloxi Marshland Waterfowl development	6,887	16,713
Total Expenditures	<u>358,705</u>	<u>500,218</u>

EXHIBIT 4

DINGELL-JOHNSON ACCOUNT

<i>Means of Financing</i>	<i>Actual 1958-59</i>	<i>Estimated 1959-60</i>
Federal's Share of Expenditures	\$ 59,429	\$ 79,885
State's Share of Expenditures....	19,809	26,628
Total	<u>79,238</u>	<u>106,513</u>
Analysis of Expenditures:		
Management coordination—the administration and supervision by technically trained personnel of all Federal Aid Projects.....	8,773	10,307
Fish Population investigation	29,026	29,920
Fish Population and Aquatic Conditions in Polluted Waters	21,281	25,500
Evaluation of Commercial Gear	13,974	4,797
Ecological survey of factors to establish what habitats are rich, average, or poor in production of fish food organisms.....	6,184	9,501
Statistical Analysis of Game and Fish research data		8,017
Investigate impoundment management practices for D'Arbonne and Bussy Lakes....		18,471
Total Expenditures	<u>79,238</u>	<u>106,513</u>

EXHIBIT 5

OYSTER SEED GROUND ACCOUNT

Used for the planting, propagation, cultivating, policing, preservation and distribution of oysters on and from the grounds

<i>Means of Financing</i>	<i>Actual 1958-59</i>	<i>Estimated 1959-60</i>
Fund Balance at end of Prior Fiscal Year	\$422,380	\$404,963
Add Revenues	376,551	375,000
	<u>798,931</u>	<u>779,963</u>
Less Expenditures	393,968	462,030
Fund Balance at end of Fiscal Year	<u>404,963</u>	<u>317,933</u>
Analysis of Expenditures:		
Salaries	90,308	104,312
Contractual Services	52,250	49,600
Traveling Expenses	7,077	12,346
Materials & Supplies	202,282	250,698
Special Current Charges	5,445	6,426
Equipment	36,606	38,648
Capital Outlay		
	<u>393,968</u>	<u>462,030</u>

Dedicated Revenue as set forth in Act 533 of 1950, Section 458. This tax collected on shells taken from State owned water bottom is divided equally between Oyster Seed Ground Account and Commercial Seafood Account.

EXHIBIT 6

COMMERCIAL SEAFOOD ACCOUNT

Used to administer and enforce the commercial seafood laws

<i>Means of Financing</i>	<i>Actual 1958-59</i>	<i>Estimated 1959-60</i>
Fund Balance at end of Prior Year	\$504,108	\$475,930
Add Revenues	369,231	375,000
	<u>873,339</u>	<u>850,930</u>
Less Expenditures	397,409	277,875
Fund Balance at end of Fiscal Year	<u>475,930</u>	<u>573,055</u>
Analysis of Expenditures:		
Salaries	96,076	122,511
Contractual Services	41,363	42,565
Traveling Expenses	19,867	21,983
Material & Supplies	30,036	61,802
Special Current Charges	5,468	6,952
Equipment	21,612	22,062
Capital Outlay		
Construction	182,987	
	<u>397,409</u>	<u>277,875</u>

Dedicated Revenue as set forth in Act 533 of 1950 Section 458. This tax collected on shells taken from State owned water bottom is divided equally between Oyster Seed Ground Account and Commercial Seafood Account.

EXHIBIT 7
ROCKEFELLER REFUGE ACCOUNT

<i>Means of Financing</i>	<i>Actual 1958-59</i>	<i>Estimated 1959-60</i>
Prior year's Balance	\$324,147	\$
State Appropriation for Rockefeller Fund	662,050	828,595
Fur Sales, Sale of equipment.....	242	435
	<u>986,439</u>	<u>829,030</u>
Less: Expenditures	986,439	710,263
End of year's Balance		<u>118,767</u>
Analysis of Expenditures:		
Salaries	131,844	117,202
Contractual Services	76,581	65,738
Traveling Expenses	4,739	4,022
Material & Supplies	68,280	58,322
Special Current Charges	6,869	8,121
Equipment	94,932	79,750
Capital Outlay		
Construction	603,194	377,108
Total Expenditures	<u>986,439</u>	<u>710,263</u>

EXHIBIT 8
**MARSH ISLAND AND STATE WILDLIFE
ACCOUNT**

<i>Means of Financing</i>	<i>Actual 1958-59</i>	<i>Estimated 1959-60</i>
Prior year's Balance	\$ 20,234	\$ 49,751
Drawn from Marsh Island Fund	164,700	919,200
Insurance claims for Storm damage, etc.		3,670
Fur Sales, Pasturage, etc.....	4,025	
	<u>188,959</u>	<u>972,621</u>
Less: Expenditures	139,208	203,369
End of year's Balance	<u>49,751</u>	<u>769,252</u>
Analysis of Expenditures:		
Salaries	41,641	63,023
Contractual Services	36,462	49,428
Traveling Expenses	3,114	2,766
Material & Supplies	44,114	45,116
Special Current Charges	2,770	3,512
Equipment	11,107	39,524
Capital Outlay		
Construction		
Total Expenditures	<u>139,208</u>	<u>203,369</u>

EXHIBIT 9
WATER HYACINTH CONTROL

<i>Means of Financing</i>	<i>Actual 1958-59</i>	<i>Estimated 1959-60</i>
Special State Appropriations	\$250,000	\$250,000
Appropriation-U. S. Corps of Engineers-Joint Program		58,688
Total Appropriation	<u>250,000</u>	<u>308,688</u>
Analysis of Expenditures:		
Salaries	176,157	198,172
Contractual Services	15,957	12,740
Traveling Expenses	3,640	5,496
Material & Supplies	42,671	70,920
Special Current Charges	11,182	8,218
Equipment		13,142
Total Expenditures	<u>249,607</u>	<u>308,688</u>

EXHIBIT 10
SPECIAL FUNDS

	<i>Actual 1958-59</i>	<i>Estimated 1959-60</i>
Seismic Fund:		
Balance beginning of year	\$315,284	\$415,050
Receipts	577,025	408,450
	<u>892,309</u>	<u>823,500</u>
Less: Expenditures	477,259	378,807
Balance end of year	<u>415,050</u>	<u>444,693</u>
Gulf States Marine Fisheries Commission:		
State Appropriation	7,500	7,500
Less: Expenditures	5,166	6,000
Due State Treasurer	<u>2,334</u>	<u>1,500</u>
Ducks Unlimited:		
State Appropriation	60,000	60,000
Less: Expenditures	60,000	60,000
Due State Treasurer		
Building Fund Act 21 of '55: (General Fund)		
Furniture & Fixtures	148,387	
Expenditures	148,387	
Balance		
Research in Connection with Crayfish Industry:		
State Appropriation		10,000
Expenditures		10,000
Due State Treasurer.....		

EXHIBIT 11

TOTAL BARRELS OF VARIOUS TYPES OF PROCESSED SHRIMP MARKETED DURING THE TWELVE YEARS FROM 1946-1957 AND TWO YEARS 1958 AND 1959

	<i>Total</i> 1946-1957	<i>Average</i> 1946-1957	1958	1959
Whole	596,652	49,721	32,037	29,576
Headless	2,310,430	192,536	140,012	184,236
Canned	957,692	79,808	20,282	22,440
Dried	397,625	33,135	9,327	10,406
Cooked & Peeled	231,942	19,329	6,928	7,780
TOTALS.....	4,494,341	374,529	208,586	254,438

EXHIBIT 12

MONTHLY SHRIMP PRODUCTION — 1941-1959

	<i>Six Year Montbly</i> <i>Barrel Average</i> 1941-1946	<i>Six Year Montbly</i> <i>Barrel Average</i> 1947-1952	<i>Five Year Montbly</i> <i>Barrel Average</i> 1953-1957	<i>Montbly</i> <i>Total</i> 1958	<i>Montbly</i> <i>Total</i> 1959
January	52,312	19,048	13,246	6,507	7,955
February	34,691	18,221	8,690	2,523	3,203
March	19,001	13,558	7,433	6,494	6,379
April	12,591	17,552	11,033	3,996	6,423
May	21,958	36,263	31,014	8,574	19,610
June	37,996	28,804	35,722	22,767	38,193
July	29,907	11,847	26,199	8,935	17,649
August	19,603	45,479	33,885	26,155	31,141
September	60,210	47,835	32,868	20,730	27,212
October	66,999	61,076	45,751	41,733	38,785
November	74,775	44,559	33,772	36,018	38,781
December	68,312	34,998	26,178	24,134	19,107
TOTALS	498,355	379,240	305,791	208,586	254,438

Exhibits 11 and 12 show the number of barrels of shrimp produced and marketed during 1958 and 1959 as compared to prior averaged periods. Even though both 1958 and 1959 are well

below average, shrimp production has increased considerably compared to 1957, which was an exceptionally poor year. (See Exhibit 15).



A portion of Grand Isle shrimp fleet in port.

EXHIBIT 13
LOUISIANA SHRIMP PRODUCTION IN BARRELS PROCESSED BY AREA
FOR THE YEAR 1958

Area	Whole	Headless	Canned	Dried	Cooked & Peeled	Total Bbls.	Percent
La. Shrimp Processed in Other Gulf States.....	120	.....	6,384	.....	.....	6,504	3.1
French Market	10,934	.....	.....	.....	.....	10,934	5.3
N. O. Area, St. Bernard and Plaquemines Parish.....	1,654	8,062	2,228	1,542	.....	13,486	6.5
Lafourche Parish	11,678	25,323	.....	.....	.....	37,001	17.7
Terrebonne Parish	1,638	25,058	10,360	7,347	6,928	51,331	24.6
Jefferson Parish	2,342	38,739	1,310	438	.....	42,829	20.5
St. Mary and all other parishes to Texas line.....	3,671	42,830	.....	.....	.....	46,501	22.3
Total 1958 Production	32,037	140,012	20,282	9,327	6,928	208,586	100.0

EXHIBIT 14
LOUISIANA SHRIMP PRODUCTION IN BARRELS PROCESSED BY AREA
FOR THE YEAR 1959

Area	Whole	Headless	Canned	Dried	Cooked & Peeled	Total Bbls.	Percent
La. Shrimp Processed in Other Gulf States.....	229	.....	6,294	.....	.....	6,523	2.6
French Market	16,358	34	.....	.....	.....	16,392	6.4
N. O. Area, St. Bernard and Plaquemines Parish.....	175	9,551	1,037	330	.....	11,093	4.4
Lafourche Parish	8,531	47,010	.....	.....	.....	55,541	21.8
Terrebonne Parish	721	34,608	12,405	9,804	7,780	65,318	25.7
Jefferson Parish	259	39,609	2,704	273	.....	42,845	16.8
St. Mary and all other parishes to Texas line.....	3,303	53,423	.....	.....	.....	56,726	22.3
Total 1959 Production	29,576	184,235	22,440	10,407	7,780	254,438	100.0

Area production as presented in Exhibits 13 and 14 shows the relative concentration of shrimping activity along the Louisiana coast for 1958 and 1959. Ratio and quantity changes between areas from period to period are important for both economic and biological study.

EXHIBIT 15
SHRIMP PRODUCTION AND NUMBER OF TRAWLS
AND/OR SEINES

<i>Calendar Year</i>	<i>No. Barrels Shrimp (210 lbs.)</i>	<i>No. of Seines</i>	<i>No. of Trawls</i>
1913	50,000	131	.....
1914	52,381	131	.....
1915	57,143	268	.....
1916	85,714	.....	.....
1917	57,143	.....	.....
1918	71,429	300	17
1919	76,190	.....	.....
1920	152,381	97	499
1921	163,012	135	983
1922	109,050	111	699
1923	153,749	128	1,021
1924	150,624	143	905
1925	154,722	180	1,010
1926	123,967	143	692
1927	150,896	120	913
1928	195,303	261	1,454
1929	210,033	125	1,486
1930	197,550	172	1,176
1931	178,815	126	1,131
1932	152,373	66	699
1933	166,058	67	1,045
1934	226,576	107	1,441
1935	252,981	125	1,433
1936	286,749	30	1,920
1937	362,942	35	2,313
1938	363,656	13	1,662
1939	395,050	26	1,621
1940	397,189	5	3,016
1941	554,354	5	3,028
1942	489,173	4	2,380
1943	441,445	4	2,101
1944	544,378	4	1,866
1945	495,994	4	2,373
1946	464,981	4	3,030
1947	365,617	4	3,408
1948	376,605	4	3,200
1949	376,040	4	3,310
1950	361,365	3	2,819
1951	396,980	0	2,248
1952	398,952	0	2,277
1953	437,340	10	3,543
1954	451,647	4	3,442
1955	365,542	5	3,276
1956	318,130	7	3,072
1957	181,061	9	2,419
1958	208,586	9	4,400
1959	254,438	8	4,154

Exhibit 15 is a historic record of the shrimp industry in Louisiana from 1913 through 1959. It is evident that the shrimp industry is a very important part of our economic system.

EXHIBIT 16
1958
NUMBER OF RESIDENT AND NON-RESIDENT
TRAWL BOATS BY PARISH & STATE

<i>Parish</i>	<i>40 Feet & Under</i>	<i>Over 40 Ft.</i>	<i>Total</i>
Acadia	5	3	8
Allen	3	....	3
Assumption	2	1	3
Calcasieu	169	16	185
Cameron	77	15	92
Iberia	64	17	81
Iberville	3	....	3
Jefferson	660	92	752
Jefferson Davis	8	2	10
Lafayette	5	1	6
Lafourche	159	142	301
Livingston	5	....	5
Orleans	320	58	378
Plaquemine	173	61	234
St. Bernard	136	34	170
St. Charles	39	9	48
St. John	15	....	15
St. Landry	2	....	2
St. Martin	4	....	4
St. Mary	88	178	266
St. Tammany	23	13	36
Tangipahoa	29	....	29
Terrebonne	573	341	914
Vermilion	147	72	219
Total Louisiana	2709	1055	3764
<i>State</i>			
Alabama	15	59	74
Florida	4	21	25
Mississippi	126	241	367
Texas	140	30	170
Total Non-Resident	285	351	636
Grand Total	2994	1406	4400

Exhibits 16 and 17 present the number of trawl boats that were licensed for the years 1958 and 1959. These figures are presented by parish for Louisiana and state for non-resident boats. The



Louisiana shrimp are cuisine delight the world over.

EXHIBIT 17
1959
NUMBER OF RESIDENT AND NON-RESIDENT
TRAWL BOATS BY PARISH & STATE

<i>Parish</i>	<i>40 Feet & Under</i>	<i>Over 40 Ft.</i>	<i>Total</i>
Acadia	4	1	5
Allen	3	....	3
Assumption	2	....	2
Calcasieu	158	17	175
Cameron	71	13	84
Iberia	66	16	82
Iberville	2	....	2
Jefferson	633	85	718
Jefferson Davis	8	2	10
Lafayette	5	2	7
Lafourche	162	132	294
Livingston	5	....	5
Orleans	299	55	354
Plaquemine	161	60	221
St. Bernard	135	31	166
St. Charles	40	8	48
St. John	12	....	12
St. Landry	3	....	3
St. Martin	3	....	3
St. Mary	80	174	254
St. Tammany	19	12	31
Tangipahoa	30	1	31
Terrebonne	532	319	851
Vermilion	140	69	209
Total Louisiana	2573	997	3570
<i>State</i>			
Alabama .....	....	54	54
Florida	2	36	38
Mississippi	77	228	305
Texas	129	58	187
Total Non-Resident	208	376	584
Grand Total	2781	1373	4154

relative concentration of these vessels remains fairly constant even though the number may vary considerably from season to season depending upon the catch.



Shrimp are sorted and ready for market.

EXHIBIT 18
COMPARATIVE STATEMENT OF FRESH AND SALT WATER COMMERCIAL FISH
PRODUCED BY LOUISIANA FISHERMEN — 1957 AND 1958

<i>Fresh Water Fisheries</i>	<i>1957 Pounds</i>	<i>1958 Pounds</i>
Catfish	4,417,700	6,788,400
Gaspergou	1,185,700	1,525,500
Spoonbill	277,100	76,100
Buffalo	3,223,100	3,847,600
Garfish	671,800	1,247,900
Common Fish	159,600	625,700
Fresh Water Turtles	43,700	195,500
Crayfish	866,500	2,171,100
Frogs	18,900	59,900
Baby Green Turtles—(1,255,000-Number).....	25,100 (830,000-Number)	16,600
TOTAL	10,889,200	16,554,300
<i>Salt Water Fisheries</i>		
Sea Turtles	200	3,500
Speckled Trout	572,500	592,100
Red Fish	353,300	487,500
Sheepshead	81,900	138,900
Flounders	186,700	137,000
Red Snappers	28,200	87,800
Pompano	200	3,800
Mullet	335,800	528,700
Drum	183,700	179,800
Miscellaneous	146,000	7,550,200
Hard Shell Crabs	8,559,400	9,336,300
Soft Shell Crabs	551,300	576,500
TOTAL	10,999,200	19,622,100
TOTAL FRESH AND SALT WATER FISHERIES	21,888,400	36,176,400

Exhibit 18 indicates that 1958 was an excellent year for both fresh and salt water fisheries. 1957 was an average year as compared to prior year figures. Even though 1959 production figures are not complete, indications are that it was also a very good year. (This Exhibit excludes oyster, shrimp and menhaden production figures which are presented in separate reports).

EXHIBIT 19
LOUISIANA MENHADEN PRODUCTION BY UNITS
ONE UNIT = 666 POUNDS (APPROXIMATELY 1,000 FISH)

<i>Company</i>	<i>4 Year Total Unit Average 1954-1957</i>	<i>1958 Units</i>	<i>1959 Units</i>
Louisiana Companies:			
Empire Menhaden Co.			
Empire, La.		71,686	139,000
Fish Meal Co.			
Morgan City, La.			67,202
Gulf Menhaden Co.			
Cameron, La.		117,679	219,628
Louisiana Menhaden Co.			
Cameron, La.		100,066	126,000
Quinn Menhaden Co.			
Empire, La.		71,347	120,900
Total Louisiana Companies	380,785	360,778	672,730
Mississippi Companies:			
Fish Meal Co.			
Moss Point, Miss.		46,000	54,700
Mississippi Menhaden Co.			
Moss Point, Miss.		19,938	25,992
Standard Products Co.			
Moss Point, Miss.		29,000	27,200
Wallace M. Quinn Fisheries			
Pascagoula, Miss.		6,840	13,120
Total La. Production— Mississippi Companies	124,176	101,778	121,012

Texas Companies:			
Port Arthur Menhaden Products			
Port Arthur, Texas		9,629	17,424
Quinn Menhaden Fisheries			
Port Arthur, Texas		3,341	7,752
Total La. Production—			
Texas Companies	38,992	12,970	25,176
GRAND TOTAL.—			
LA. PRODUCTION	543,953	475,526	818,918

NOTE: The production figures shown opposite the Mississippi and Texas Companies represents their respective production in Louisiana waters only, as derived from information furnished by these companies.

Exhibit 19 shows the Louisiana menhaden production for 1958 and 1959 as compared with a prior averaged period. According to available statistical records which go back to 1951, 1959 production set a new high. The previous record year was 1955 with a total Louisiana unit production of 680,486 units.

According to valuation figures received from each of the companies, the 1959 total processed value to the industry was approximately \$14,500,000 for the oil, meal and solubles derived from the Louisiana catch. Menhaden oil, meal and solubles have many uses. Some of the more important ones are as follows:

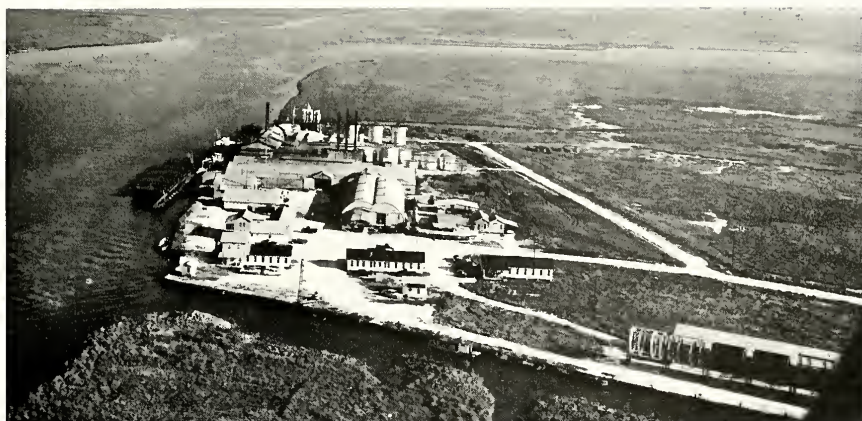
1. *Oil*
 - a. Base for linoleum, paint and soap.
 - b. Tempering metals.
 - c. Various vitamin compounds.
 - d. Base for lipstick and other cosmetics.
 - e. The U. S. Government has started major scientific investigations into the use of fish oil in reducing the cholesterol level in the blood stream. Cholesterol is believed to be one of the principal factors in causing high blood pressure and heart disease.

2. *Meal*
The meal or pulverized scrap is used to manufacture high protein feeds for farm animals and poultry.

3. *Solubles*
The thick paste remaining after the oil and meal have been removed is used as an additive to farm animal and poultry feeds and a small portion is used to manufacture high quality liquid plant food.



MENHADEN of average size caught in Louisiana waters weigh upward of $\frac{3}{4}$ pound to a pound apiece. These fish are typical of those caught in mid-summer.



TYPICAL MENHADEN PROCESSING PLANT is this installation of the Louisiana Menhaden Company at Cameron, Louisiana. Fish oil and solubles are stored in large tanks at upper end of plant. Sacked fish meal is shipped from Quonset-like warehouse.

EXHIBIT 20 COMPARISON OF NUMBER OF COMMERCIAL FISHING AND DEALERS LICENSES SOLD BY CLASS 1958 AND 1959

<i>Class of License</i>	<i>1958 Number Sold</i>	<i>1959 Number Sold</i>
Commercial Fisherman Bait Seller	1128	883
Hoop Net	1365	1483
Fresh Water Fish Seine	142	231
Fresh Water Trammel Net	363	401
Fresh Water Gill Net.....	1247	1331
Salt Water Fish & Shrimp Seine.....	58	61
Salt Water Trammel Net.....	156	150
Wholesale Dealer — Fish and Seafood.....	298	294
Wholesale Dealer's Agent	90	87
Retail Dealer — Fish and Seafood	3181	3584
Total	<u>8028</u>	<u>8505</u>

The general trend of the licenses listed in Exhibit 20 is a good barometer of the anticipated commercial fresh and salt water fisheries catch for any particular year. (See Exhibit 18) 1958 was an excellent production year and the 1959 increase in license sales would indicate another exceptional year. Complete production statistics for 1959 are not as yet available, however, both shrimp and menhaden figures which are complete show sizable increases.

EXHIBIT 21
NUMBER OF HUNTING LICENSES SOLD
SEASON 1939-1940 TO 1958-1959, INCLUSIVE

<i>Season</i>	<i>Total Licenses</i>	<i>Hunting Resident Season</i>	<i>Hunting Non-Resident Season</i>	<i>Hunting Non-Resident 4-Day Trip Season</i>
1939-40	98,167	93,587	1,335	3,245
1940-41	116,653	115,336	166	1,151
1941-42	146,648	144,349	495	1,804
1942-43	119,543	118,300	163	1,080
1943-44	94,609	93,334	181	1,094
1944-45	124,485	121,767	407	2,311
1945-46	162,872	160,795	409	1,681
1946-47	170,396	169,652	744	*
1947-48	176,715	175,482	1,233	*
1948-49	222,201	221,702	499	*
1949-50	235,447	234,964	483	1,140
1950-51	235,472	234,195	137	1,140
1951-52	235,855	234,177	192	1,486
1952-53	209,665	207,428	169	2,068
1953-54	251,488	248,496	**2,992	.....
1954-55	242,456	239,695	**2,761	.....
1955-56	246,731	243,756	**2,975	.....
1956-57	287,810	284,844	**2,966	.....
1957-58	284,279	281,708	**2,571	.....
1958-59	275,622	272,756	**2,866	.....

NOTE:

* No trip licenses issued during these years.

** Non-Resident sold on a reciprocal basis beginning with the 1953-54 season. These licenses include both season and trip.

EXHIBIT 22
NUMBER OF ANGLING LICENSES SOLD
YEARS 1939-1958, INCLUSIVE

<i>Year</i>	<i>Total</i>	<i>Angling Resident</i>	<i>Angling Non-Resident</i>	<i>Angling Non-Resident 7-Day Trip</i>
1939	27,096	12,649	14,447	**
1940	31,014	16,140	14,874	**
1941	52,695	38,080	*14,615	.....
1942	41,661	30,608	*11,053	.....
1943	36,112	29,492	3,332	3,288
1944	33,239	25,755	3,743	3,741
1945	35,002	27,000	4,088	3,914
1946	52,909	42,621	5,808	4,480
1947	64,055	59,353	4,702	**
1948	66,797	63,657	3,140	**
1949	82,942	72,397	5,970	4,575
1950	83,068	72,044	5,872	5,152
1951	89,337	76,516	6,477	6,344
1952	102,715	89,159	6,207	7,349
1953	205,049	178,994	10,087	15,968
1954	217,282	187,832	12,048	17,402
1955	220,835	187,466	13,917	19,452
1956	218,757	186,106	14,817	17,834
1957	188,874	159,664	14,124	15,086
1958	192,290	165,566	13,364	13,360

NOTE:

* Includes both annual and 7-day trip.

** No 7-day trip licenses issued during these years.

Exhibits 21 and 22 give historic records of the number of sport licenses sold from 1939 through 1958 for angling and from the 1939-40 season through the 1958-59 season for hunting. The total number of licenses sold has remained fairly constant for the past six years and seasons.

These figures do not even approach the number of persons in Louisiana who enjoy the abundance of our hunting and fishing grounds. An undeterminable number of resident and non-resident persons alike are excluded from the purchase of these licenses as follows:

1. All resident women are eligible for free permanent fish-

ing licenses.

2. All resident persons who have reached their sixtieth birthday and have actually resided within the state for two years prior to application, are issued free permanent permits to hunt and fish.

3. All resident and non-resident persons on active military duty are exempt from the purchase of sport licenses.

4. All resident and non-resident persons under sixteen years of age are exempt from the purchase of sport licenses.

5. No resident is required to have an angling license unless a reel or artificial bait is used.

EXHIBIT 23
1958 Angling and 1958-59 Season Hunting and Trapping Licenses Sold
By Parish and State Totals as Compared to Prior Year
and Season State Totals

PARISH	Res. \$1.00	1958 ANGLING		1958-59 HUNTING		1958-59 TRAPPING
		N. R. 7-Day Trip \$2.00	Non-Res. \$5.00	Res. \$1.00	N. R. Re- ciprocal	\$2.00
Acadia	1434	10	4	5000	14	24
Allen	1167	22	8	3416	61	58
Ascension	1580	22	8	2999	0	33
Assumption	248	2	0	1569	1	80
Avoyelles	1578	213	30	4475	1	49
Beauregard	991	61	23	2808	19	32
Bienville	681	90	22	2067	2	21
Bossier	2718	586	134	3609	0	30
Caddo	13277	3631	3618	15548	47	110
Calcasieu	11671	852	4297	14758	908	124
Caldwell	363	22	7	1265	1	36
Cameron	672	73	401	1328	440	106
Catahoula	498	204	63	1802	3	16
Claiborne	813	23	35	1821	7	20
Concordia	1414	911	2146	2952	191	11
DeSoto	705	107	105	2162	10	47
E. Baton Rouge	13597	86	48	17209	18	20
E. Carroll	467	146	59	1734	14	69
E. Feliciana	222	2	12	1317	0	16
Evangeline	909	72	18	3773	1	14
Franklin	782	30	6	3371	8	39
Grant	1008	45	8	2211	1	27
Iberia	2627	11	2	4982	24	48
Iberville	994	8	5	2358	0	19
Jackson	986	60	9	2323	0	44
Jefferson	9083	5	2	7996	1	68
Jefferson Davis	1901	26	5	4037	85	124
Lafayette	3105	24	10	6853	34	6
Lafourche	2281	2	1	5806	0	170
LaSalle	980	171	20	2455	7	12
Lincoln	988	30	5	2415	6	15
Livingston	1949	56	54	4346	6	56
Madison	478	51	50	1957	66	72
Morhouse	1789	53	37	4874	27	68
Natchitoches	3109	2991	557	4614	32	45
Orleans	31019	382	176	16444	240	193
Ouachita	5631	200	24	11667	26	90
Plaquemine	575	0	1	1969	21	103
Pointe Coupee	881	72	14	2120	0	6
Rapides	5704	181	41	11125	27	55
Red River	371	196	65	1036	20	46
Richland	1035	41	6	3550	7	88
Sabine	641	27	12	2455	8	23
St. Bernard	1377	0	1	1424	0	232
St. Charles	2180	6	1	2545	0	57
St. Helena	104	0	1	928	3	10
St. James	601	1	0	1863	0	67
St. John	542	3	0	1243	0	62
St. Landry	3499	67	20	8863	10	48
St. Martin	504	6	0	2420	1	45
St. Mary	1916	21	4	4648	21	179
St. Tammany	4102	143	239	4356	24	61
Tangipahoa	2725	111	189	6276	17	72
Tensas	376	495	199	1583	29	30
Terrebonne	3105	12	1	6077	1	321
Union	631	36	102	2453	17	37
Vermilion	1327	20	4	4875	300	131
Vernon	1070	66	27	3151	6	43
Washington	2151	53	213	5285	24	41
Webster	2774	331	134	4324	2	52
W. Baton Rouge	1958	6	2	1933	0	1
W. Carroll	427	42	12	2514	17	69
W. Feliciana	179	3	4	879	1	1
Winn	1096	231	63	2540	9	40
TOTAL SOLD	165566	13360	13364	272756	2866	3932
1957 & 1957-58	159664	15086	14124	281708	2571	3868
Increase	5902	.....	.....	.....	295	64
Decrease .....	.....	1726	760	8952	.....	.....
% Increase	3.7%	.....	.....	.....	11.5%	1.7%
% Decrease .....	.....	11.4%	5.4%	3.2%	.....	.....

Exhibit 23 is prepared each year as soon as returns for these classes of licenses are complete. Each sheriff handles the distribution, collection and remittance from the sale of these licenses in his respective parish with the exception of Orleans Parish where these functions are carried out by our main office.

AVIATION SECTION

JOHN ELLINGTON

Chief Pilot

Aviation was first introduced to Wild Life and Fisheries on December 1, 1940, when the service of a pilot, along with the use of a pilot's seaplane, was secured and put to work on a trial basis with the understanding that the service would have to be proven to be of aid to the department before the arrangement would become permanent.

From that humble beginning, the demand for increasing air service has grown until today the commission operates, maintains, and owns the following four airplanes: Two Gruman Super Widgeons that are twin engine amphibious type airplanes; one is five place, has two 270 h.p. Lycoming engines; the other is six place, with two 295 h.p. Lycoming engines. Two Cessna 180's; one on amphibious floats that is four place and has one 230 h.p. Continental engine; the other on straight wheels that is a four place and has a 230 h.p. Continental engine. The commission also obtained, through the Federal Government Surplus Property offices, three helicopters. These helicopters are not in operation as yet but are expected to begin operation in the fiscal year of 1961, solely for enforcement, aerial photography, water pollution control, etc.

Approximately fifty per cent of all flying is devoted to enforcement of fish and game laws.

After a number of meetings between interested parties in the shrimping industry and the Wild Life and Fisheries Commission, the 1958 session of the Louisiana Legislature passed a new Act to control the taking of shrimp. In comparison to the former Act, the new law was much more effective and much stricter. The Aviation section, along with the Enforcement division, was charged with the responsibility of seeing that no one violated the Act. During the month of July, 1958 the Aviation section flew 193 hours and 15 minutes, and covered a total of 30,880 miles enforcing the new shrimp law. On the first day, 29 arrests were made by the Aviation section. Soon thereafter, violations were practically nil.

Needless to say, this law, with the constant patrolling of the airplanes caused a rise in the take of shrimp. Twenty-five per cent more than the preceding year. Louisiana ranked third in the nation previously, and in the very near future, should again rank first in the production of shrimp due to strict enforcement and continuous air patrol. It can be noted at this point that in 1958 Texas, Mississippi, and Alabama decreased their production of shrimp; Florida increased her production one per cent, while Louisiana increased her production 25 per cent.

In this atomic age, flying wild life agents are not exactly a novelty, but the Louisiana Wild Life and Fisheries Commission is finding its flying agents extremely valuable in the enforcement of fish and game

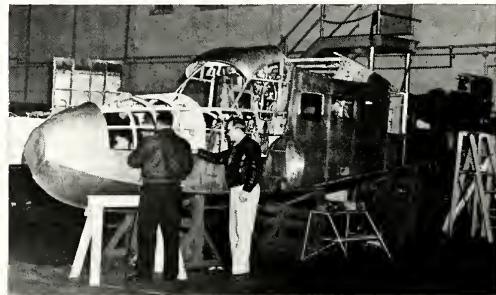


Three helicopters have been assigned to the Louisiana Wild Life and Fisheries Commission by the Louisiana Civil Defense Agency. John Ellington, chief pilot of the wildlife aviation section, at right, is receiving the copters from, left, Major Adolph Brocato of the Air National Guard, and John Boh of the Civil Defense Agency.

laws, and the law violator has found that the approaching drone of an airplane motor is a forerunner of an arrest.

In the days before the airplane was put into use by the commission, fish and game violators played a merry game of tag with agents in the Louisiana bayous and marshes. Knowing the labyrinth of canals, bayous, and lagoons as they knew the decks of their own boats, they had little difficulty in dodging the enforcement officers, but they are unable to dodge, hide or lose the radio-equipped planes. Ducking into shallow bayous and marshes, where the patrol boats of the commission cannot go, doesn't give them sanctuary either. A patrol plane pilot can spot the violator, radio his location, and direct boat borne officers to him if necessary, or, if the water or terrain is suitable for landing, the flying wild life agents can make the arrest themselves.

"Flying Squadrons" of wild life agents are being employed with excellent results in all part of the state. These units are sent out from headquarters in special squads wherever violations of considerable number are reported. Because they are not known in the areas into which they are rushed, they are able to avoid the identification which too many times



Three licensed aircraft and engine mechanics keep the commission air fleet on the alert at all times.



The twin engine Gruman Super Widgeon plays an important part in the enforcement of our game and fish laws and lends aid to all other programs of the Louisiana Wild Life and Fisheries Commission.

warns the violator in time to take cover, and in a few hours these wild life agents have been known to clean up entire communities where illegal hunting and fishing has been reported. The work of these squadrons is increasing daily, and the effect is being felt throughout the entire state, with the result that much game and countless fish are being saved from illegal destruction.

The remaining 50 per cent of flying is devoted to all other divisions of the commission such as assisting in the work of making biological tests, transporting scientists, and providing them an opportunity to study from the air certain conditions and formations that would be far less discernible from land or water surfaces; assisting the Division of Education and Publicity in the taking of aerial photography; speedy transportation for outdoor writers and photographers for publications of national scope; transportation of commission personnel when speedy arrival at a given destination is essential in behalf of public relations; and the transportation of visiting writers on whom the Division of Education and Publicity must rely in publicizing Louisiana's wildlife resources; participating in the taking of game census throughout the state,

on game reservations and land open to public hunting; lending a vital service to individuals where rescue work is urgently needed before and after storms; aiding in the rescue of persons and valuable wildlife during floods; aiding in the search for lost persons, boat crews and land and water conveyance; being available at all times to aid in the search for drowned persons, for boats overdue at their home ports, and all other types of emergency relief and rescue work.

This section also gives assistance to various federal agencies in their wildlife and conservation work in Louisiana as well as aids state agencies other than the Louisiana Wild Life and Fisheries Commission; full cooperation with all divisions of the commission whenever and wherever an airplane is needed to make their work simple and more successful.

This section also has its own hanger at the New Orleans airport with a completely equipped machine and repair shop capable of doing any sort of repair or renovation work needed to keep the flying equipment in A-1 condition. I may add, that by having our own maintenance shop, the cost of operation is approximately 50 per cent of what it would be if all



Two Cessna 180's, one on amphibious floats, have been added to the fleet of the flying wildlife officers.

work were contracted out.

A second amphibian ramp was constructed at Rockefeller Refuge in 1959. This ramp with the one at Pass-a-Loutre enables our airplanes to taxi out of the water for the purpose of refueling and unloading supplies, and in case of bad weather, to remain overnight, also in case of emergencies, repairs may be effected.

The personnel of the Aviation section consists of the Chief Pilot and two other fully accredited pilots, each of long experience in aviation, three licensed aircraft and engine mechanics, one mechanic helper, and one stockroom clerk and clerk-typist. Detailed reports of the work done by each of these individuals as well as the cost of maintenance of the section are submitted monthly to the director of the commission.

During the past few years, considerable and favorable publicity has been given the aviation section of the Wild Life and Fisheries Commission by

several leading magazines. One publication in particular, "The Saturday Evening Post", singled out this unit as the outstanding one of its kind in the United States and carried a most colorful account of the activities of Louisiana flying wild life agents along with pictorial matter showing how they "got the job done." Also "True Adventure" magazine ran a story showing the hazards of enforcing the law by airplane.

That the Aviation section has become one of the important cogs in the machinery of the entire Wild Life and Fisheries Commission is unquestionable. Aside from its value as a law enforcement unit, the speed with which this air service can get division personnel to distant points means a great saving in time and money. Trips that would take eight to ten hours by automobile or boat may be made in an hour or less by airplane.

"The speed with which the world moves today must be matched if we are to keep pace."

THE WHARF

CLAUDE LE BLANC

Superintendent

Affectionately known as the "Wharf" the Marine and Radio repair department of the commission is a trouble shooter for the organization and is under the administrative division.

Located on the New Basin canal, at 7612 West End Boulevard, the "Wharf" takes care of all boats of the commission in need of major repairs and its crew of 19 men are on hand to take care of breakdowns in the field. When it is not feasible to return the equipment to the wharf, crews are sent out to effect on-the-spot repairs anywhere in the state.

At the wharf proper, where full radio and machine repair equipment is maintained, more than fifty major repairs are effected yearly on "haul-outs". The wharf handles such jobs as that recently effected on the exploratory vessel *Albacore* which was completely rebuilt and rearranged to provide better and more convenient living quarters for its crew and scientific equipment for biologists' use on their research trips into the waters of the Gulf of Mexico.

Averaging two to three minor motor repairs to the commission equipment per day, crews of the wharf also service the commission's 165 trailers in the field. In addition, the wharf takes care of refrigeration, radio, renovation, and painting of boats and maintains a ten-ton hoist for dry-docking.

Throughout the year it is the duty of "Wharf" personnel to see to it that the commission's 32 large craft, 146 small boats and 250 outboard motors are kept "rolling."



The WHARF is charged with radio repairs and installations. Above are seen Bob Smothers and Sterling Jastram in the radio repair section.

Besides boat repairs, the wharf is charged with repairs to installations and boat houses at the commission's refuges and installations and repairs to radios in automobiles, maintenance of walkie-talkies, and the like. Also all equipment of the commission's radio transmission stations are installed by the wharf's crews. Several years ago when installations and radio towers were severely damaged by a violent storm, the "Wharf" was commended by the commission for the swift manner in which crews went into the area and repaired and rebuilt storm tower buildings and serviced radio installations.

Purchasing for the field such as marine supplies for boats, radios, supplies for camps and the like are handled through the wharf. Communication by means of a fixed radio transmitter with remote control through the main office makes it possible to maintain constant communication with boats, planes and mobile units operating throughout the State of Louisiana at all times. Besides the outboard motor shop, the marine repair shop and the carpenter shop, the Wharf maintains a warehouse for stock parts and materials.



The commission's boats, large and small, are repaired at home port, the WHARF. In the center is seen the ten-ton hoist used for dry-docking.



The commission's 250 outboard motors are kept in tip-top shape at the WHARF. Outboard repairs average more than two a day. Mechanic James Beckler is seen working on one.



More than 50 major repairs on "haul outs" are effected at the WHARF each year.

INFORMATION AND EDUCATION

STEVE HARMON

Chief



STEVE HARMON

THE DIVISION of Information and Education is the clearing house of the Louisiana Wild Life and Fisheries Commission. From this office emanates most of the information concerning this agency's activities, rules, and regulations, which are aimed primarily at the conservation of Louisiana's wildlife resources.

To continuously and diplomatically put its message over to the public, the commission's program requires the use of every medium known for the dissemination of information. Consequently, the employees of this division must not only be experienced in public relations, but must also be constantly in touch with every department of the commission in order to be able to present any part of the overall operations to the man on the street.

As we have said, no one medium could possibly serve to meet the various demands of the general public for enlightenment as all have their specific requirements when seeking information. It is to this division that the individual, the civic clubs, the schools, bureaus, and institutions of various kinds; the press, radio, and television look to for the answers, and for services of various kinds.

Because of the fact that the demands for more forms of outdoor recreation are becoming greater as our population expands, the public is constantly seeking places where to go, where to hunt, fish, swim, and commune with nature. Consequently, the commission is not only looked to as a natural source of such information, but is also charged with the supplying of information and location of Louisiana's well-stocked hunting and fishing grounds. All of which adds up to the fact that this division must create good will, through its various mediums of contact, for all the departments of the commission. These contacts are used and developed in many fields, and each takes a special skill to develop.

As television has loomed in the picture as an important medium for disseminating information, the division has gone along with it, and with added special services for it. Radio, newspapers, nationally circulated popular magazines and publications dedicated to fishing, hunting, commercial fishing and allied industries, are used as mediums to convey our message to the public at large, whenever possible. To profit by the

use of media such as these, this division must not only provide written material, but factual data, brochures, photographs, maps, and motion pictures. It must send its representatives to all parts of the state to be attendant at meetings, give informational lectures and show motion pictures when required.

In September of 1959, the division instituted pilot conservation education classes on a small scale in two schools in Lafourche parish, at Golden Meadow High School, and the Larose-Cut Off High School. The plan was such a success and so enthusiastically accepted that State Superintendent of Education Shelby Jackson authorized the commission to conduct special wildlife work in all of the state's schools.

For the pilot course, a special mimeographed text was prepared by Lloyd Guidry, teacher in the Golden Meadow school. In it are included such things as a diagram of a shrimp trawl; descriptions of pink, white and brown shrimp; an explanation of the 1958 Louisiana law, which made it illegal to shrimp during certain months of the year, and the text is complete with even a glossary of shrimp boat slang. The two high schools presented an ideal setting for the successful experiment since the students were taught, along with other things about our wildlife; facts about something that is in the very mainstream of their lives, because shrimp affect the lives and livelihood of practically every resident of the area in some way or other.

The course was set up through the cooperation of the commission, the Louisiana Shrimp Association, the United States Fish and Wildlife Service, the Lafourche School Board and the State Department of Education. During the course the eighth grade students, along with members of the school's biology classes, made a trip to Grand Terre Island, across Barataria Pass from Grand Isle. The object of their bus and boat trip was to view the major marine laboratory of the

Louisiana Wild Life and Fisheries Commission.

One of the foremost efforts in conservation education is the publication of the LOUISIANA CONSERVATIONIST, a monthly magazine which has an unsolicited and ever-mounting circulation. At present, the total circulation of this magazine, which originated in 1948, is 65,000. This is an increase of 20,000 subscriptions over the past two years, and new requests have been coming in at the rate of an average of 600 per month.

During the two-year period, the magazine has devoted more and more space in explaining the commission's policy and program to the public. It has likewise utilized the services of the commission's biologists in writing articles on scientific matters of interest to its readers. The magazine has gained not only mounting favor statewide, but its articles, feature stories, and editorials have been reprinted by conservation magazines in our sister states, and its prestige ranks with the best in the country.

In addition to publishing the LOUISIANA CONSERVATIONIST, the division must also publish a biennial report to the legislature. This report, in book form, has been made so comprehensive in its content that it is not only used for the enlightenment of the legislators, but is also widely used in the state's schools and libraries as a source of factual data on wildlife and its management.

It is also the day to day responsibility of the division to originate all news releases developing in the commission, all directives from the director and the division heads, as well as special material for outdoor writers, newspaper columnists, and contributors to national magazines which cover the fishing and hunting fields.

There is an ever-increasing demand from outdoor

writers for national magazines for information on Louisiana's world-famous fishing and hunting and it is through the competent and prompt service given these individuals that the division has been able to bring Louisiana's message before the national reading public and to acquaint sportsmen throughout the country with Louisiana's potentialities for their enjoyment of sports afield and astream.

At the present time, we have in publication a brochure on Louisiana birds which has been developed through information gathered by individuals in the department. We have also published brochures on the Louisiana nutria, shrimp, and oysters. These brochures have been added to our stock of like publications on frogs, spiders, snakes, crabs, and frogs, etc.

The Wild Life and Fisheries Museum, which has been housed in the Presbytere opposite Jackson Square in New Orleans, is in the process of being moved to the Wild Life and Fisheries Building at 400 Royal Street. This magnificent structure, which occupies the entire square, including landscaped terraces, will afford ample room for the present exhibits and for those which are constantly being added to. With its 3,000 exhibits of wildlife and fish, the museum is considered one of the finest in the United States and its renovated quarters, which are to be scientifically lighted and which are being designed by museum experts and artists and will attract many of the millions of tourists who file by the building yearly. Also on the architects drawing boards are plans for a Gulf Marine Hall where the fishes of the Louisiana Gulf Coast will be displayed in their simulated natural settings.

In connection with the museum, there will be an auditorium, with a seating capacity of 300, where visitors and children from the hundreds of school classes which visit the building will be shown wildlife mo-



EDOUARD MORGAN
Museum Curator



EDNARD WALDO
Staff Writer

tion pictures and hear conservation lectures. Along with the operation of the auditorium, the commission is moving its film lending library which consists of films on the various phases of wildlife and which are also shown on request to visiting school classes, civic and sportsmen's clubs and to boy and girl scout groups. The division has recently added 45 new films to the library and purchased three new projecting machines.

A commission-produced motion picture on the importance of Louisiana's oyster industry to the state's economy is now in the making and first release of this narrated, color film is expected by June of 1960.

Another important phase of the department's wildlife educational program is the construction and maintenance of wildlife exhibits that are shown throughout the state at wildlife conventions, fairs, and kindred assemblies where they are widely in demand and serve to convey the message of conservation directly to the people. Each exhibit is designed and arranged to depict the animals and habitat of the section in which it is shown.

To carry on this division's efforts and to supply the demand for pictures of all kinds for its own publications as well as for others, this division is constructing a new and modern dark room for the purpose of processing and printing its own pictures and is moving its dark room equipment from the Presbytere.

In addition to servicing publications, television and radio, this division does considerable work among youth groups such as 4-H clubs, boy and girl scout organizations, school classes throughout the state, lecturing and showing sound movies concerning conservation of our wildlife resources. Members of the staff have assisted in arranging displays, conducting classes, organizing new clubs and providing them with suitable materials to carry on their work.

In the adult field, members of the staff have attended meetings of civic groups, wildlife clubs, conventions and like gatherings to further educate the public on the activities of the Wild Life and Fisheries Commission.

The personnel of the division consists of the Chief who is also editor of the LOUISIANA CONSERVATIONIST, a writer, who prepares material for the magazine, special wildlife features and news releases; two secretaries; one taxidermist and technician, and his assistant, who builds exhibits and backgrounds; a librarian for the film library; a receptionist and a museum maintenance man. All members of this staff have been indoctrinated in wildlife conservation work and work in close harmony with other divisions of the commission in keeping the general public informed of the commission's conservation efforts and who enthusiastically dedicate themselves to better education and public relations for the protection of Louisiana's wildlife resources.

ENFORCEMENT DIVISION

JULIUS BOOK

Acting Chief

During the past two years, game agents of the law enforcement division of the Louisiana Wild Life and Fisheries Commission have made almost three thousand arrests for violations of the state's game laws. Numbers, however, don't prove everything; let it suffice to say that these, in a majority of cases, have resulted in convictions for the violators, which is a tribute to the excellent training of its personnel.

The division is now headed by Captain Julius Book, veteran enforcement man, who has seen many years of service with the commission and is regarded as an authority on Louisiana's shrimping and oyster waters. Book, who was assistant enforcement chief, succeeded Rudolph P. Easterly in June, 1959, when Easterly assumed the directorship of the commission.

It has been interesting to note that as each two years roll by, the enforcement division has consecutively won its accolade with the press and public. Four years ago, its personnel were cited for their



JULIUS BOOK

heroic rescue work during one of Louisiana's worst hurricanes. During the past two years, its work in making effective the state's closed seasons on shrimp, which has aided in the comeback of the Louisiana shrimp crop, has been acclaimed by the press and the shrimping industry.

"A law is only good if you can enforce it", and this has been the byword of the enforcement division. As an example: During the 1958 Legislature, a bill, backed by the scientific findings of the com-



ANTHONY BERNI
Agent III



BEN DAHLEN
Agent III

mission and the shrimping fraternity, was passed making certain seasons closed to allow the immature shrimp to grow on their nursery ground thus allow for a bumper crop to be produced.

Now, whereas this law met with approval of the majority, there were certain elements from both within and without the state operating in our waters who heartily disapproved, and on the first day the closed season went into effect, promptly and deliberately set out to break the law. No sooner had they done so than the malefactors felt the full force of the law enforcement division, which was determined to make the law "stick." Drove of agents descended upon the closed areas by patrol boat and planes and within 24 hours the waters were swept clean of the violators and their boats and nets impounded and their illegal cargoes distributed to charitable institutions.

The result was that when the season was opened again there was, as predicted by the commission's biologists, a bumper crop of shrimp—the best seen in decades. This has been followed by another closed season and another bumper crop of shrimp. Louisiana is now well on its way to regain its place as first shrimp producer of the nation. A greater part of this important story of success may be chalked off to the men of the enforcement division.

Enforcement of our game laws first got under way in 1908 when the Louisiana Legislature created a commission for the Protection of Birds, Game and Fish. In 1912, this commission merged with the state's oyster commission under the name of Department of Conservation. In 1944, an amendment was passed separating the Department of Wild Life and Fisheries from the old Department of Conservation, and by an amendment in 1952, the Louisiana Wild Life and Fisheries Commission was



FRANK TROCHIANNA
Agent III

established, under which the present enforcement division functions.

From the beginning, the enforcement division has made great strides in the preservation of our natural resources, and today it is recognized as one of the nation's leading wildlife conservation protection agencies. It is staffed by agents, who, for the most part, have been thoroughly trained in enforcement.

Another function added to the duties of enforce-



LESMA HEBERT
Southern Supervisor



DEWEY FARRAR
Northern Supervisor



Arrests for violations such as these are not made haphazardly. After two weeks of surveillance Agent II, Harry Reno, left and Agent I, Earl Gorio, right arrested two men with the spiked bucks seen above at the Reserve Canal, in St. John Parish. In center is Chief of the Law Enforcement division, Captain Julius Book. The deer were taken in closed season.

ment personnel has been the thorough cooperation with the Civilian Defense Agency. In order that wildlife game agents may be prepared to assist in the event of a national emergency, general Civil Defense briefing sessions were conducted by Lewis Parrish, State Civil Defense Training Officer at the division's regular six months inventory and radio equipment check meetings, held by Ben C. Dahlen and Robert Smothers in the 15 districts, which were attended by all personnel during the month of July 1959. It is felt that through this training the enforcement personnel will be in a position to offer valuable assistance in the event of enemy attack or any other national emergency.

Working directly out of headquarters, or under direct supervision of Captain Book, are: Anthony Berni, in charge of records; Ben C. Dahlen, D. L. Farrar, Lesma Hebert, and Frank Trocchiano, each of whom have long periods of service with the law enforcement division of the commission, which when totalled, amounts to approximately 137 years.



Game agents of the law enforcement division not only check illegally taken game and fish at their sources, but also at their outlets. This batch of more than 700 pounds of white perch and bass, which are game fish, were confiscated from a Baton Rouge fish market by game agent L. U. Jarreau after a raid on the establishment. The fish were confiscated and turned over to two local orphanages.

In addition to the men listed above, the law enforcement division employs 153 Agent I's, 14 Agent II's, one investigator, seven boat captains, two boat operators, and four deckhands, making a total of 188 employees in the wildlife conservation protective division.

For enforcement purposes, the state's 64 parishes are divided into 15 districts, each district supervised by an Agent II. The state is further divided into two sections: Northern and Southern.

The northern section is coordinated by a wildlife Agent III, who resides at Shreveport, Louisiana, and is made up of the parishes of Bossier, Caddo, DeSoto, Red River, Claiborne, Webster, Bienville, Jackson, Union, East Carroll, Morehouse, West Carroll, Richland, Lincoln, Ouachita, Natchitoches, Sabine, Vernon, Rapides, Grant, Winn, Avoyelles, Madison, Tensas, Franklin, Caldwell, LaSalle, Catahoula, and Concordia.

The southern section, coordinated by a wildlife Agent III, residing in Labadieville, Louisiana, comprises the parishes of Beauregard, Allen, Jefferson Davis, Calcasieu, Cameron, Evangeline, St. Landry, Pointe Coupee, West Baton Rouge, Iberville, Lafayette, Acadia, St. Martin, West Feliciana, East Feliciana, St. Helena, Tangipahoa, Washington, St. Tammany, Livingston, East Baton Rouge, Ascension, Vermilion, Iberia, St. Mary, Assumption, Terrebonne, Lafourche, St. James, St. John the Baptist, St. Charles, Jefferson, Plaquemines, St. Bernard, and Orleans.

As the inroads of civilization are constantly increasing our enforcement problems. The division believes that it is necessary that equipment be able to excel that used by violators. Need for better and faster motors, boats and cars, may readily be seen if the present standard of enforcement is to be maintained.

Every agent employed by the enforcement division has been supplied with a boat, motor, and trailer to increase his efficiency in whatever section of the state he operates. There are 29 state-owned cars being operated in the field at this time, and 109 two-way radios in State and privately-owned vehicles.

The Wildlife and Fisheries Commission maintains 22 radio towers located at the following points: Grand Pass, Bay Gardene, Pass-a-Loutre, State Wildlife, Marsh Island, Sister Lake, New Iberia, Abbeville, Pecan Island, Rockefeller, Opelousas, Baton Rouge, Franklinton, New Orleans, DeRidder, Red Dirt, Alexandria, Ferriday, Minden, Monroe, Sabine Pass and Grand Terre.

The following large boats are being used by the Enforcement Division for coastal patrol to enforce laws and regulations pertaining to commercial fishing and shrimping: Black Mallard, Safety Craft 192, Safety Craft 193, 20-U-19, Zoric, Barracuda, Wahoo, Pintail and Tarpon.

It is anticipated that the following equipment will be needed to replace old and obsolete equipment and add to the equipment already in use in order that the division may meet the rising enforcement problems which now confronts it: nine automobiles, 50 two-way car radios, 60 boat trailers as replacements; approximately 50 trailer

tongues as replacements for trailers now in use which are unsafe, 25 pairs of wheels for boat trailers, 200 trailer tires, 40 10-horsepower outboard motors, 20 40-horsepower outboard motors and 6 75-horsepower outboard motors for shrimp patrol in coastal waters, 20 18-horsepower outboard motors for patrol work in the interior of the State, 20 14-foot speed hulls, 15 16-foot speed hulls, 2 110-diesel engines, and approximately \$2,000.00 will cover radio parts for repair and maintenance of existing two-way car radio sets now in use.

The Division likewise operates a wharf located at West End Boulevard, where motor boat repair and maintenance work is done. Airport facilities are also maintained at the commission's hangars at New Orleans Airport where the planes are housed, repaired and serviced.

Among the many important arrests made during the past two years was that made by game agents of the law enforcement division, in cooperation with federal game agents. It was one of the largest seizures of illegal ducks and coots recorded in recent history totaling 376 birds. Nineteen men were seized and arrested.

Eight of the nineteen men were arrested in Lafourche parish at the Dufrene club, near Des Allemands, and the Sphar Commercial Hunting club. Eleven of the other hunters were taken at the Wag-gaman Pond Commercial Hunting club in Jefferson Parish. Participating in the seizure were: Fred A. Williams, Jack Bates, and Lodgar Duct, all United States agents; Billy Ranson, Ulysse Ougel and Lloyd Songe, all agents of the Louisiana Wild Life and Fisheries Commission. Williams said that 257 of the birds were ducks, while the rest were coots.



Shown above are from left to right Harry Reno, Agent II, B. C. Dahlen, Agent III, Earl Gorio and Harold Schexnayder, Agent I's, with a doe and fawn illegally taken in the Blind River area by two Grammercy hunters.

The following is a list of fish and game arrests made by the law enforcement division in the years 1958 and 1959:

Violations by Parishes	1958	1959
Acadia	14	9
Allen	16	18

Violations by Parishes	1958	1959
Ascension	43	42
Assumption	17	23
Avoyelles	47	26
Beauregard	14	5
Bienville	27	18
Bossier	19	2
Caddo	9	2
Calcasieu	43	34
Caldwell	3	7
Cameron	76	42
Catahoula	12	11
Claiborne	3	0
Concordia	63	10
DeSoto	13	16
East Baton Rouge	5	21
East Carroll	6	5
East Feliciana	7	1
Evangeline	28	32
Franklin	5	12
Grant	22	24
Iberia	38	21
Iberville	32	57
Jackson	6	4
Jefferson	31	39
Jefferson Davis	20	11
Lafayette	12	44
Lafourche	124	89
LaSalle	3	4
Lincoln	8	10
Livingston	22	17
Madison	4	24
Morehouse	48	26
Natchitoches	35	24
Orleans	31	45
Ouachita	11	7
Plaquemines	61	59
Pointe Coupee	14	5
Rapides	10	25
Red River	11	5
Richland	21	17
Sabine	2	3
St. Bernard	30	35
St. Charles	31	23
St. Helena	4	5
St. James	43	46
St. John the Baptist	7	6
St. Landry	59	58
St. Martin	24	41
St. Mary	19	42
St. Tammany	63	54
Tangipahoa	43	8
Tensas	34	56
Terrebonne	89	47
Union	10	14
Vermilion	40	15
Vernon	0	0
Washington	4	28
Webster	1	1
West Baton Rouge	10	11
West Carroll	13	10
West Feliciana	1	2
Winn	7	12
	1568	1410

Type of Violation	1958	1959	Type of Violation	1958	1959
Angling Without License.....	17	17	Hunting Squirrel in Closed Season.....	67	157
Commercial Fishing Without License.....	6	20	Hunting Dove Illegal Hours.....	0	1
Selling Fish Without License.....	11	2	Hunting and Killing Dove from Automobile.....	3	0
Electrocution of Fish.....	23	38	Hunting at Night from Automobile.....	0	0
Trawling Without License.....	1	11	Possession Over Limit of Squirrels.....	1	5
Trawling at Night.....	5	0	Possession Over Limit of Rabbits.....	1	0
Trawling for Crabs.....	0	0	Possession Over Limit of Doves.....	8	7
Trawling in Closed Waters.....	56	63	Hunting Dove in Closed Season.....	30	50
Seining in Closed Waters.....	5	0	Killing Doe Deer.....	51	59
Possession of Undersized Fish.....	8	9	Trapping Song Birds.....	2	0
Possession of Over Limit Game Fish.....	33	27	Hunting Deer in Closed Parish.....	8	3
Possession Game Fish for Sale.....	19	8	Hunting Deer in Closed Season.....	40	20
Possession Undersize Shrimp.....	54	5	Hunting Deer on Public Roads.....	20	8
Possession Undersize Crabs.....	3	0	Hunting and Killing White Ibis.....	0	0
Taking Alligators in Closed Season.....	5	7	Hunting Frog in Closed Season.....	77	50
Possession Over Limit Mig. Waterfowl.....	55	87	Hunting Frog in Illegal Methods.....	14	12
Possession Illegal Deer Meat.....	37	17	Hunting Rabbits in Closed Season.....	29	35
Hunting Mig. Water Fowl Illegal Hours.....	18	25	Hunting Turkey in Closed Season.....	7	6
Selling Migratory Water Fowl.....	0	0	Hunting Snipe in Closed Season.....	7	0
Hunting and Killing Woodduck.....	3	1	Hunting and Killing Grosbec.....	32	3
Hunting Migratory Waterfowl Closed Season.....	49	30	Hunting and Killing Rail in Closed Season.....	2	6
Hunting Migratory Waterfowl Without Duck Stamp.....	16	12	Hunting and Killing Crane.....	1	0
Hunting on State Preserve.....	62	46	Hunting on Private Property.....	0	0
Fishing Game Fish Illegal Tackle.....	75	33	Firing the Feeding and Breeding Ground of Wild Birds and Wild Quadrupeds.....	0	0
Fishing Commercial Fish Illegal Tackle.....	47	30	Trawling with Illegal Trawl.....	2	0
Fishing Without Non-Resident License.....	91	21	Hunting & Killing Protected Birds.....	5	0
Fishing With Explosives.....	0	0	Dredging Natural Oyster Reef in Closed Season.....	0	8
Commercial Fishing in Closed Waters.....	0	0	Possession of Undersized Alligators.....	0	6
Hunting Fur Bearing Animal With Gun.....	7	6	Failing to Return Permits at Specified Time.....	0	3
Hunting Fur Bearing Animal With Dog.....	2	0	Trapping Rabbits With Box Traps.....	0	2
Hunting from Power Boat.....	92	39	Trawling With Double Trawls.....	0	21
Hunting and Killing Robins.....	13	1		1568	1410
Trapping Without License.....	4	0	The following is a list of total fines collected in Justice of the Peace Courts, District Courts, and Federal Courts, during the years 1958-1959, for game law violations:		
Trapping Out of Season.....	1	3	Justice of the Peace Courts.....	\$ 3,801.95	
Trapping on State Preserve.....	0	1	District Courts.....	25,816.25	
Camping on Refuge.....	5	0	Federal Courts.....	5,706.00	
Pollution of Stream.....	1	0	Fines collected in the J. P. Courts are turned over to the Parish School Boards.		
Blocking of Stream.....	24	14	In addition there were 101 cases nolle-prossed, 76 cases on probation, 78 jail sentences, 32 minors, and 33 suspended fines.		
Taking Oysters from State Leased Bed- ding Grounds.....	0	0	Game law violators of Louisiana have paid a total of \$35,324.20 in fines as a result of intense activity by state game agents, in addition 78 vio- lators served jail sentences.		
Shooting Fish.....	0	0			
Operating Hunting Club Illegal.....	0	0			
Hunting Mig. Water Fowl in Baited Pond.....	5	0			
Hunting and Killing Hen Turkey.....	1	1			
Hunting Woodcocks in Closed Season.....	1	1			
Resisting Arrest.....	1	3			
Transporting Fish Out of State Illegal.....	0	0			
Hunting Without License.....	50	46			
Hunting at Night.....	227	307			
Hunting With Unplugged Gun.....	20	13			
Hunting Quail in Closed Season.....	8	4			

FUR DIVISION

TED O'NEIL

Chief



TED O'NEIL

Although Louisiana fur production is today nowhere near the fifteen million dollar a year mark it once achieved, our state is still the foremost section of the United States in fur animal pelt production. In fact, it is greater in this regard than any area of its size on the North American continent.

Louisiana produces more pelts of fur animals every year than are produced by all of the provinces of Canada; this production is primarily due to the state's muskrat and nutria produced in the 4,000,-000 coastal marsh acres. The state's fur economy has dropped from a \$15,000,000 peak reached in 1946, to the two and one-half million mark at present.

The following tables demonstrate the comparison between the Louisiana fur industry as it was in its heyday and as it is at the present:

1945-46 Season			
Muskrat	8,337,411	@ 1.50	\$12,506,116.50
Nutria	8,784	@ 5.00	43,920.00
Mink	168,598	@ 15.00	2,528,970.00
Raccoon	244,502	@ 1.50	366,753.00
Opossum	90,433	@ .50	45,216.50
Otter	2,367	@ 20.00	47,340.00
Skunk	12,224	@ 1.00	12,224.00
Fox	3,823	@ .50	1,911.50
Cat	1,430	@ .50	715.00
Miscellaneous .	37	@ .50	18.50
Total	8,869,609		\$15,553,185.00

1958-59 Season			
Muskrat	1,302,606	@ .80	\$ 1,042,084.80
Mink	88,365	@ 8.00	706,920.00
Raccoon	68,139	@ 1.00	68,139.00
Otter	5,166	@ 14.00	72,324.00
Nutria	461,311	@ 1.00	461,311.00
Opossum	3,660	@ .10	366.00
Fox	33	@ .25	8.25
Skunk	623	@ .15	93.45
Cat	126	@ .25	31.50
Total	1,930,029		\$ 2,351,278.00

Nonetheless, the state has held its top position as a producer of raw furs throughout the years although commercialization by non-related industry has made great inroads on the original fur-producing habitats.

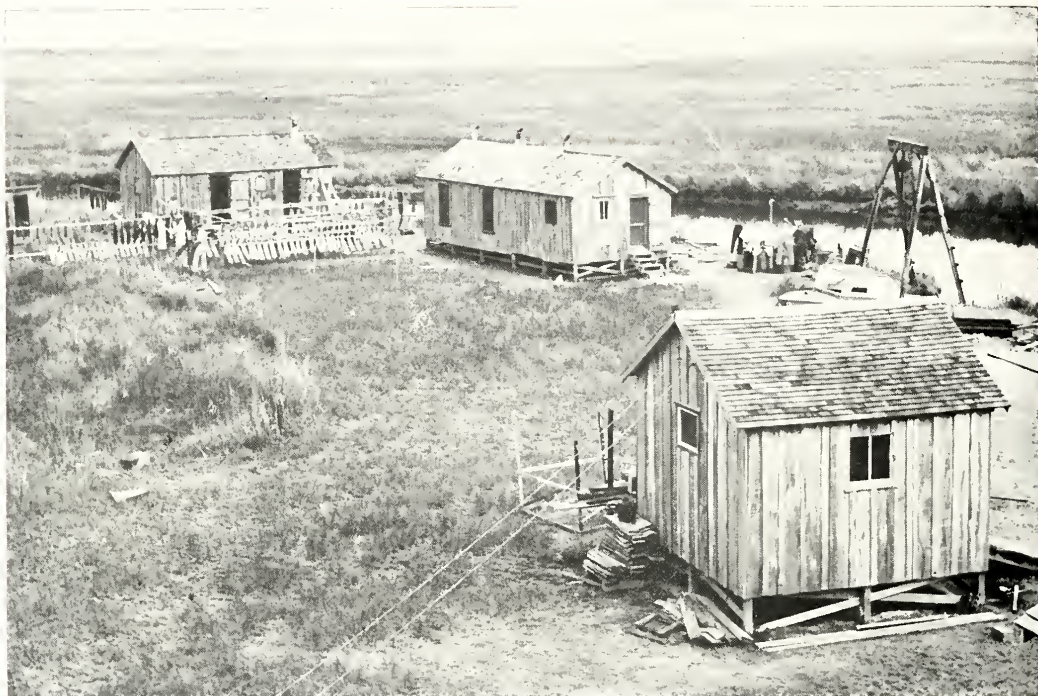
If we would pause and look back on it we would realize that the trapping industry has not only served as one of the states finest resources, but has produced the necessary revenues and means of occupation of large marsh and swamp tracts whereby the ownership has been maintained, apparently awaiting the present day industry.

The introduction of nutria into the Louisiana marshes has created a controversial and provocative situation. There were many varied opinions as to whether the nutria was beneficial or detrimental to the fur industry in Louisiana. Unfortunately, the situation was such that we had no choice in the decision. The fact remained that we were confronted with an exotic and prolific fur-bearer. The only practical approach was to devise some method of solving the ever-increasing population.

Many theories were propounded to exterminate the nutria, such as: outlawing and placing a bounty; originate a deadly poison to eradicate them; inoculation by a specific virus that would be trans-



Releases of healthy wild muskrat stock have not improved the muskrat populations even in marshes appearing to be perfect habitat for this fur bearer. Such experiments bring us to realize how badly additional detailed research is needed.



This scene is a normal one for the 1959-60 season showing one trapper's camp out of three being occupied and demonstrates the necessity for popularizing Louisiana furs. Demand for these products will put the trappers back into the marshes.

mitted, etc. However, after a great deal of research and investigation we found that the bounty system has never worked satisfactorily in any place in the United States. At the suggested figure of 10¢ a tail, it was estimated that the amount of tails that could be redeemed would cost the State of Louisiana a million dollars annually plus administration cost.

A deadly poison to eradicate the nutria also presents many problems such as contamination of all wildlife and domestic animals. A transferable virus that was meant to be a specific for nutria might develop into a disease infecting other animals and perhaps humans, we found.

The original habitat of the nutria has been the South American countries. Nutria fur garments have been accepted and desired by every well-dressed woman on the European continent.

Thus, having obtained sufficient information to be confident that Louisiana nutrias were comparable to the South American species and in many instances superior, we, of the Louisiana Wild Life and Fisheries commission, were of the firm opinion that we had one other alternative and that was to endeavor to raise the price of nutria pelts and garments by increasing the public demand for them. This, it was felt, would create a cycle whereby the trapper would be induced to trap more nutria and this stepped up activity, it was felt, would be a great factor in controlling nutria populations. In turn, the trapper would prosper financially as would the landowner and the State of Louisiana eventually through its excise taxes on furs.



This natural Louisiana nutria jacket will be highly acceptable in fashionable circles when it becomes well known.



Normal muskrat populations have not returned to this area which was overrun by nutria as the two before and after pictures above show. The creation for a widespread demand for nutria furs through promotion would attract more trappers to return to the marshes and help alleviate the nutria overpopulation. Although it leads the nation and Canada in pelt production, Louisiana has not yet appropriated money for their promotion.



Nutria have been feeding off this three-cornered grass marsh. Whereas nutria do not attack the muskrat physically, the harm done to the muskrat feeding grounds has caused a decrease in their number. Note the nutria have left this marsh appearing as though it had been uprooted by hogs.

To this end, a promotional program and well-rounded program hitting every facet of the industry, the skin merchant, the manufacturer, the retailer, and of course, the consumer, was suggested.

To this end, we devoted more than eight months in conferences with the world's leading fur people. In response to our recommendations for a wide publicity and advertising campaign for the promotion of "Fashion in Louisiana Nutria" the leaders in the industry further recommended that the leading designers of the world such as Christian Dior, Pierre Balmain, Balenciago, Fabiani, and Simonette be urged to create new fashions for fur-lined coats, jackets, capes and sweaters to be made of nutria or lined with nutria. The models created in Paris and Rome would be duplicated by manufacturers in New York and would be publicized in the fashion magazines such as *Vogue*, *Harper's Bazaar* and *Mademoiselle*. With the foregoing as a foundation both for Louisiana as a fur-bearing state and the endorsement of the leading designers of the world, through the creation of new models and through the fashion magazines presenting this as a new vogue, this would insure nation-wide fashion acceptance. We recommended the publicizing of the romantic story of Louisiana as the greatest fur-bearing state in the United States and the employment of the cooperation of the outstanding New York fashion firms to contact television, newspaper columnists, radio and fashion shows; making every effort not only to attract the already fur-minded women, but also to create an interest among the vast numbers of high school and college girls where great dormant fur buying power lies.

Besides taking the aforementioned steps towards control of the nutria, the Fur division was active

and responsible for the enacting of legislation whereby farmers and landowners were issued permits enabling them to use any means to control nutria on their properties. A law was later enacted outlawing the nutria. This latter legislation, however, was not recommended by the commission. As an added service, the Fur division has sent its field workers to aid the farmers and landowners to assist and supervise methods of controlling nutria in all cases where assistance was requested.

At the same time, the Fur Division employed the assistance of the Agricultural Research Division of Louisiana State University, who ran a series of experiments on the nutrient value of nutria meats to determine whether the nutria carcasses were suitable for mink and pet feed. The results proved that the carcasses were of the highest quality in nutrient value and even excellent for human consumption.

Acting upon the reports from LSU, the Fur division immediately inaugurated, through our Coastal Vocational schools, an educational program whereby all trappers were instructed in the proper handling and care of nutria carcasses for this purpose. Samples of the product were shipped to several mink ranchers and pet food canners and the meats met with immediate acceptance as the mink ranchers were particularly pleased with the high protein content and negligible amount of fatty substances.

The result was that more than two million pounds of the meats were used by the mink and pet food people last season and so far all that the trappers have been able to bring to market this season has been eagerly absorbed through this medium.

Thus by creating one more incentive to the trapper to take the nutria to market and enhance his income, the Fur division has taken one more step towards control of the animal.

The Fur division feels that the aforementioned has enabled the trapper to supplement his income to the extent that he will continue in the nutria trapping business thus enabling the Fur division to hold the trapping industry together awaiting the time when the pelts themselves will bring a suitable price.



These plantation workers thought that by stopping up the nutria burrows they could avoid further damage to this levee. The occupants simply burrowed out and the levee had to be repaired again the next day.

FISH AND GAME DIVISION

T. B. FORD
Acting Chief



T. B. FORD

The activities and services of this division during the past two years were directed towards the improvement of fishing and hunting opportunities through research, development, management and habitat preservation. A statistical unit was established to assist with the design of research projects and analysis of data. The final reports of two research projects were published. Approximately 100,000 acres of land and water areas were acquired for making available to the public and development is in progress on these and previously acquired areas.

Two phases of management were bolstered by the Commission. One was the holding of a highly publicized two-day public hearing in early July to provide all interested sportsmen and public officials an opportunity to present their views about hunting regulations for the approaching season. These were considered with the recommendations of the wildlife biologists prior to the adoption of the regulations at the regular late July Commission meeting. Shortly afterwards, a synopsis of the adopted regulations including a map of deer hunting areas was published and distributed statewide. This practice will be followed in future years. The other phase of management was the provision of buck and doe deer hunting on some game management areas where needed.

A joint federal-state aquatic weed control program was initiated which augmented the existing hyacinth control program. This should greatly increase the availability of waters for fishing, hunting, and other purposes.

The fisheries management program for lakes, ponds and streams was improved in the past two years. Now, waters are checked by a fisheries team in order to determine the needs prior to treatment, such as, total poisoning, selective poisoning, selective commercial fishing, and stocking, and to eliminate costly indiscriminate stocking of fish. Successful techniques for rearing crappie (white perch) and channel catfish were devised to meet the increased demand for these species. Considerable effort was devoted to the preservation of fish and wildlife habitat, but was insufficient to meet the rapidly increasing needs.

The most characteristic aspect of the past two years is the dynamic working atmosphere in which conditions and situations were continually shifting. Accordingly, the efforts of the technical and non-technical personnel of this division have varied in emphasis to keep abreast of these ever-changing developments in meeting our obligations. Even so, every effort has been made to maintain a continuity in the basic divisional programs.

Progress means advancement. In the case of this division's responsibilities, it means the application of the best management procedures available to provide the maximum fishing and hunting opportunities commensurate with the preservation of the fish and wildlife species. This requires two basic functions in view of the state-wide rapidly changing ecological conditions in the upland, bottomland, marsh and water areas. One is the uninterrupted services of competent fish and wildlife technicians who have been trained to observe, measure, record and report the results of applied research projects. The other is the implementation of approved practices and management of fish and wildlife according to research findings applicable to the various sets of condition.

The accomplishment of this objective rests not only with the personnel of this division and the Commission, but also with the citizens of the state through their support. For example, hunting seasons are regulated to permit the harvest of surplus game. This is scheduled, in most cases, when reproductive activities are at a minimum and prior to critical food shortages. Two basic factors normally determine the general level of abundance. (1) Suitable habitat (food and cover) and favorable environmental conditions. When both these are favorable, good reproduction and populations can be expected—exceptions to this relate to time lags, evident among some species. (2) The harassment by men and dogs and the illegal taking (outlawing) of game can influence the levels of reproduction and available numbers of animals for the next season or even future years. This is especially applicable to deer and turkey.

The dynamics of nature through its intricate system of checks and balances exact a toll annually. This is to be expected and efforts of control are generally of very limited value. However, harassment and outlawing of game are subject to control. All citizens

contribute to this control, positively or negatively, if by no other means than through their attitudes.

Laws and regulations have been adopted in the interest of the honest citizens' use of these resources. Accordingly, they will not derive greater benefits of fish and wildlife resources until they unite in the positive, substantial and vigorous support of the wildlife laws and regulations. This requires (1) the reporting of willful violators, (2) assisting with the apprehension of violators, and, (3) making known their wishes to the district attorneys and judges for the prosecution and sentence of the guilty as provided by law. The application of this procedure has contributed much in some areas of the state. In summary, personnel of this department can accomplish only part of the job of making fish and wildlife available; all of us must work together to attain maximum benefits.

Similarly, it is in our interest to recognize that the quality of the habitat basically governs the levels of abundance and use by wildlife. Rapid ecological changes generally are detrimental to fish and wildlife. This is every citizen's interest again for a substantial number of the projects affecting these resources are *public* projects. All too infrequently, only very few people are in a position to know what effects and results can be expected to occur from a project. There is *no report to the people*, who are interested in the project-influenced area, prior to authorization or installation of the project. Thus, it becomes obvious that developments or projects may represent progress for one or a few interests, while it is damaging to other interests. In working with renewable resources, products of land and water such as fish and wildlife, we are concerned with immediate and long term advances and progress in the wise use of these resources. There is an increasing awareness of and interest in these problems by our citizens who are recognizing "Why?" fish and wildlife populations are decreasing in some areas and who want to know "What?" will happen before any changes are made. This is an improved picture which has become more evident in the past few years. In our opinion, this represents substantial progress in this area.

Turning to the more tangible aspects of this division's program, we are able to denote steps of progress in several fields. This has been achieved by recognition of the problems at various levels by citizen groups and government. Through this recognition, the problems are being reduced to their component parts whereby some solutions were derived and placed into practice immediately. Other solutions are dependent upon funds, changes in the law, education or time.

In the water field, advances have been made in fisheries research and management. Expensive practices of fish rescue and ill-advised, random stocking of fish were replaced by lake or stream surveys to determine biological needs. Through the application of various research and management practices including selective or total poisoning, selective seining and/or other net fishing, commercial fishing and fluctuation of water levels, more desirable fish populations should be available in the future for the harvest. This should provide more fishing opportunities in Louisiana's public waters. However, concurrently and foremost among these needs is the provision of public

access to these waters.

The aquatic weed control program has been accelerated through a cooperative agreement and contract between this department, the Department of Public Works and the Corps of Engineers, U. S. Army. This should make available more waters which have been plagued with the water hyacinth and other plants susceptible to treatment. Our aquatic plant research program needs to be augmented in order to find suitable control methods for many other noxious plants rapidly developing in the many clear water areas isolated from backwaters of major streams.

Much of the game research effort was devoted to the accumulation and analysis of data to provide a firm basis for management recommendations. Since our responsibility is statewide, then consideration must be given on the basis of providing maximum opportunities for the most hunters commensurate with the resources, rather than to the advantage of minority groups. Accordingly, this work can benefit the hunters by providing longer seasons and better bag limits when production is good.

Rapid strides were made in game management. Buck and doe or "hunter's choice" hunts were held on the game management areas where this practice was needed. The four primary purposes were (1) to bring the deer in balance with the carrying capacity of the range, permitting a recovery of browse species which had been overbrowsed, (2) to maintain the deer in a healthy condition, (3) to provide maximum deer hunting opportunities, and, (4) to reduce crop damage in adjacent agricultural areas.

Based upon previous hunter response records on game management area hunts, we were concerned about obtaining sufficient hunting pressure to provide the necessary harvest. Accordingly, the schedule was arranged to obtain the maximum number of hunters. The response greatly exceeded our expectations, resulting in an over-concentration of hunters on some areas. Plans for future hunts should reduce or eliminate this problem. Harvest of surplus game is achieved best and most logically by the sportsmen. We were pleased with the level of harvest. However, we would not expect the total kill to be as high next year even though we are interested in securing the maximum harvest permissible while keeping the deer in balance with the range.

This problem emphasized the necessity of an expanded land acquisition program, through lease or purchase, to meet the sportsmen's needs for places to hunt. For a number of years, personnel of this department have pointed this out repeatedly. Now, this is recognized by a large number of people who should be interested in supporting this program. Two areas were inspected last year; the one acquired was suitable for waterfowl development, while the other proposed for purchase was considered to be too small.

Development of previously acquired areas progressed orderly. These areas should provide improved hunting opportunities.

On June 30, 1959, John S. Campbell, Chief, retired after more than thirty years of state service. The duties and responsibilities were assigned to the acting chief.

More detail progress reports of the various sections' work is given in subsequent parts of this report.

RIVER BASIN STUDIES

SECTION

T. B. FORD

Supervisor

The preservation of bottomland swamp and marsh wetland areas in a natural state holds the key to the generally high sustained future production of fish and wildlife resources in many parts of Louisiana. Similarly, the future levels of use by fishermen, hunters and trappers is also dependent, in part, upon progress in this direction.

It is the purpose and responsibility of this section to coordinate the investigation and evaluation of all proposed water control projects in the state to determine whether they will be detrimental to fish or wildlife resources. Upon completion of the studies, reports including recommendations are prepared and submitted to local, state and/or federal agencies, and also to various public groups. Occasionally, some proposed projects will have essentially no effect on fish or wildlife due to the limited scope of the project or the low quality of the project area. In other situations, a feasible modification of plans can be incorporated which will preserve fish and wildlife habitat in conjunction with the proposed development. There are still other situations where the type of proposed project is such that no compromise is available for fish and wildlife losses cannot be prevented. This is due to factors such as the substantial direct losses of habitat to right-of-ways and the cumulative indirect losses of adjacent areas over a period of several months or even years as a result of construction. In the latter situation, when projects are approved and funded regardless of the detrimental influence on fish and wildlife habitat, then every effort is made to cooperate with the planning agency to minimize losses through measures such as control and disposal of spoil, detailed location and alignment of route to avoid high quality areas, and the incorporation of other features to favor water qualities, levels and flows.

There can be little doubt that the vast majority of past, present and pending water control projects were considered a necessity by the people who asked for them. While we have been critical of many of the past and authorized projects, it has not been intended to imply that these projects should not have been constructed, but rather that much of the damage to fish and wildlife resources could have been prevented with proper foresight, planning and coordination of effort. In the opinion of most technically trained conservationists, gross and cumulative changes in the ecology of the state occur as a result of man's effort to occupy sub-marginal environments. These technical people are concerned with the fact that such changes are occurring which affect most of the renewable natural resources and, more particularly, that over a period of twenty-five to fifty years these changes may be

irreversible for many of these resources. Thus, in our opinion, these factors emphasize the need for, as well as, require careful, comprehensive multi-purpose considerations by all interests in approaching water resource problems.

The development of interest in and appreciation of fish and wildlife problems in connection with water control programs by other groups is probably the most important work which can be performed by the Commission in meeting its responsibilities as defined by law. Approximately one-third of the state's area is considered as wetlands and a great percentage of the fish and wildlife resources utilize these areas. Preservation of fish and wildlife habitat is necessary since annual and future production of these resources is dependent upon environmental conditions. For example, some fish and wildlife technicians recognize that a single navigation project constructed in the marshes can affect thousands of acres of marsh lands, waters, and waterbottoms, including their plants and animals by ecological changes resulting from the project. The cost of a restorational program just to keep pace with one or two such projects would overtax the total resources of the department. At best, even this could not result in a complete return to the previous or a more favorable condition. Thus, prevention of damage and destruction of habitat is still the best treatment for preservation of fish and wildlife resources. If a project affecting fish and wildlife habitat detrimentally is considered to be necessary, then its sponsors and planning agencies should include provisions for rehabilitation in the project cost.

During the past two years, 1958-60, a shortage of personnel and additional responsibilities have necessarily limited and confined efforts primarily to the major water control projects. This is not to infer that the cumulative effect of the hundreds of smaller projects is inconsequential, but that physical limitations of personnel dictated this. The cumulative effect of these small projects results in staggering losses to fish and wildlife when considered from a statewide basis. No personnel were assigned to this work full time since none were available for this purpose. In addition, inadequate funds did not permit full implementation of this program.

A brief summary of the projects studied or continued from earlier years is given below.

Mississippi River-Gulf Outlet Project—This project was initiated in 1958 after being authorized in 1956 and is designed to provide deep draft navigation from the Gulf of Mexico southeast of New Orleans into the city at the Industrial Canal. Upon completion, it will be 36 feet deep, 500 feet wide at the bottom, and about 77 miles long. Since this channel bisects highly productive estuarine water and marsh areas, this department has been greatly concerned about the influence on fish and wildlife resources. In addition to the immediate influence on the annual fish and wildlife value of 10 to 14 million dollars and direct losses to valuable habitat, we anticipate considerable indirect losses due to changes in currents, saltwater intrusion, drifting of spoil into adjacent areas, and other project associated factors.

Every effort was made to secure a modification

in the channel alignment to minimize damages to an area having an annual estimated fish and wildlife value of 10 to 14 million dollars. This proposed realignment would have bypassed high quality waterfowl marshes and oyster water bottoms, and confined the middle section of the new channel within the natural levees of Bayou La Loutre, thereby making available more suitable material for retention dikes. This recommendation was rejected by the Corps of Engineers, the planning and contracting agency, because it would increase the construction and maintenance cost by going through the lower part of Lake Borgne and, presumably, for other constructional reasons. However, a careful benefit-cost study was not made of this proposal. Accordingly, we shall continue to question whether their cursory review justified the incurrence of valuable habitat losses in view of the fact that some states are spending millions of dollars trying to establish the type of waterfowl area which was virtually destroyed here.

A biological study designed to evaluate the project-influenced area over a period of several years and to provide recommendations covering aspects of the detailed design and construction of segments of the project was initiated under the supervision of the U. S. Fish and Wildlife Service. This is a co-operative study with the Service represented by the Branch of River Basin Studies of the Bureau of Sport Fisheries and Wildlife and by the Bureau of Commercial Fisheries. Some work has been contracted with a private marine research foundation. The Commission has cooperated with the Service in several aspects of the study and has assisted in the coordination of the various recommendations and reports in an effort to minimize damages. The Corps of Engineers has cooperated with these groups in most instances by providing for retention dikes and weirs to minimize spoil distribution and by providing for the most suitable water circulation pattern in affected marshes through borrow pits and bayou openings in critical locations as recommended by the fish and wildlife interests.

Barataria Bay Waterway Project—The existing project, completed in 1925, provides for a 5-foot deep channel 50 feet wide from the junction of Bayous Villars and Big Barataria to Barataria Pass at Grand Isle. In July 1958, Congress authorized an enlargement to 12 feet by 125 feet from the Intracoastal Waterway to the 12-foot contour in the Gulf south of Grand Isle. However, this modification provided for a realignment along the western shore (through the islands) from Bayou St. Denis to Barataria Pass.

This department furnished the Corps of Engineers its views relative to fish and wildlife in June 1955, pointing out that there would be direct losses to oyster beds in the proposed channel right-of-way and additional damages to beds within the project-influenced area. Subsequently, it was pointed out that acquisition of right-of-way would include leased oyster grounds and that maps showing these were available in this office. In the past two years, this department has cooperated with the Louisiana Department of Public Works, the Corps of Engineers

and Jefferson Parish officials in deriving a detailed alignment to minimize damages to fish and wildlife resources including oyster beds. Nevertheless, we have emphasized that the rights of the oyster growers and their leased bottoms must be recognized. It is interesting to note that the Chief's office, Corps of Engineers, ruled almost three years ago that the federal government would not acquire any right-of-way for this was the obligation of local interest. However, it is more interesting to note that the acquisition value of right-of-way over the leased oyster beds was not included in the benefit-cost ratio.

Proposed Jefferson Seaway Project—This project would have provided for a 55 mile tidewater channel from Westwego through Barataria Pass at Grand Isle to the Gulf. Dimensions were 40 feet deep, bottom width of 500 feet, and a right-of-way area of 5,280 feet. This channel would be superimposed, essentially, over the Barataria Bay Waterway.

A preliminary report was prepared by this section as directed by the Commission with careful consideration being given to the possible effects on fish, wildlife and habitat resources as a result of the proposed construction. Anticipated hydrological changes and determined effects to this very valuable estuarine area, so richly productive of fish and wildlife resources, were emphasized. Actually, a project of this type would have a tremendous influence over an extensive area rather than being limited to the immediate construction area, for it would completely alter the existing currents and regimen of a great portion of the bay and associated water and marsh areas.

The proposed project was contingent upon a bond issue subject to the approval of the voters of Jefferson Parish. It was not approved.

Ouachita River Navigation Project—Authorizations through 1945 provided for navigation to a controlled depth of 6½ feet. Subsequent authorization in 1950 provided for a 9- by 100-foot navigable channel through Louisiana. This provided for the construction of a new lock and dam (No. 2) between Jonesville and Harrisonburg. Subsequently, in 1958 or early in 1959, this was revised and alternate locations for this particular lock and dam included the above location as well as one several miles below Jonesville. This latter proposal would affect Little River and Catahoula Lake, which are high quality fish and wildlife areas.

At a conference on March 11, 1959, Governor Long directed that a joint study be made by Director Lamar Clement, Louisiana Wild Life and Fisheries Commission, and Director Lorris Wimberly, Louisiana Department of Public Works, and their respective staffs so as to derive a plan which would eliminate any possible detrimental effects to the fish and wildlife resources of the Catahoula Lake Area. A careful study and evaluation of all related factors were made by our staff of fish and wildlife technicians. In view of the high fish and wildlife values which would be included in the overall losses and, particularly, the great waterfowl significance Catahoula Lake has not only in Louisiana but also in the entire Mississippi Flyway, the fol-

lowing recommendations were made by this department:

1. That the selection of the site for the lock and dam (No. 2) on Black River below Jonesville be abandoned because it would be detrimental to the Catahoula Lake and Little River Watersheds.
2. That the lock and dam be installed at some point between the mouth of Little River and the junction of Tensas and Ouachita Rivers in order that the Tensas River watershed may be favored by the project.
3. That the lock and dam be installed above the mouth of the Ouachita River if the above Item 2 is not feasible from an engineering standpoint.

The last report available to us indicated that the decision on this location would be made during the design stage of the project when funds were available.

It was interesting to note that there were two schools of interest and thought relative to the fish and wildlife benefits to be derived from this project. These positions seem to have been maintained for years. However, it is clearly evident to us that the natural overflow conditions of the lake and the water cycles peculiar to that area favor game and commercial fishes, waterfowl, waterfowl foods, hogs and cattle, as no other single area in Louisiana or the Mississippi Valley. Accordingly, in view of the various alterations of the many other areas as a result of drainage, levees, flood control, navigation, submarginal land encroachments, etc., it is in the best local, state and national interest to preserve this outstanding area.

Other projects considered or continued—The Mississippi River and Tributaries Project Review, which originated in 1955, was finally completed during 1959 with inter-agency coordination conferences. A large number of segments of this project have been studied and fish and wildlife recommendations for preserving and developing habitat in Louisiana were included in the report. Personnel of this department cooperated with field personnel of the Branch of River Basin Studies of the Service in this work. Among the segments included were "The Introduction of Freshwater into the Marshes below New Orleans," "Red River Backwater Area", etc.

Several "Public Hearings" were attended and reports representing fish and wildlife interests were given. Some of these related to areas such as "Bayou Dorcheat", "Bayou Bodeau and Cypress Bayou", and "Red River".

Surveys and small watershed plans were reviewed and coordinated with the Soil Conservation Service. The more prominent of these was the "Upper West Fork of Cypress Bayou Watershed" in the Plain Dealing area. This development has been specifically designed to incorporate provisions primarily for fish and municipal water needs in addition to flood detention. Local interests have obligated themselves to pay for the additional fisheries municipal water benefits as provided in the "Small Watersheds" Act as amended.

The "Freshwater Bayou Navigation Project" was

endorsed by the District and Division Engineers, Corps of Engineers, and referred to the Chief's Office in Washington. When this project was reviewed by the Rivers and Harbors Board of the Chief's Office, additional material relative to the benefit-cost ratio based upon economic studies and fish and wildlife damages was filed in behalf of affected land lessees, which supplemented this department's previous statement on fish and wildlife. Comments were furnished by this department sustaining the potential damages to fish and wildlife if the project were constructed. Essentially, a high quality extensive marsh area exceptionally valuable for waterfowl and furbearers will be damaged if this project is installed.

During the past two years, contributions were made to several special investigations, projects and reports. Included among these were the "Frank Waddill Property" in East Baton Rouge Parish which was bequeathed to the Commission, the "Conservation Education Program in Public Schools" pilot program in Lafourche Parish which is to supplement available materials and instructions on fish and wildlife resources, and "Artificial Reef Investigation and Feasibility Study", which revealed that the many off-shore platforms contribute essentially the same effect as artificial reefs and that the establishment of two experimental reefs for evaluation purposes would require a minimum of \$10,000.00.

Coordination and long-range planning or functions to contribute to the general knowledge about estuarine and coastal waters of the state for the preservation and improvement of fish and wildlife resources was continued through participation in the Gulf States Marine Fisheries Commission. Each state contributed to the compilation of references to unpublished data and material about these areas which was then published by the above Commission. An Estuarine Technical Coordinating Committee was established for the purpose of recognizing specific research needs in the Gulf Coastal and estuarine waters, outlining the scope, requirements, and objectives of such projects, evaluating these proposed projects, and then referring them to the Commission for approval and future action. This approach suggests progress and achievement.

One public hearing of great potential significance was that held by the U. S. Senate Select Committee on National Water Resources in Alexandria on December 1, 1959. A detailed statement and summary was prepared and presented to the Senate Select Committee for this department. The present day annual value of fish and wildlife resources in Louisiana was derived by our staff and found to be \$180,000,000.00. Projected over a twenty year period, it is estimated to increase to \$294,000,000.00 annually, which does not include any increased value or production from commercial fisheries and fur, since it was virtually impossible to project at this time. Past and current problems associated with fish and wildlife resources were recognized for the value these may contribute to the future preservation of these important resources. Their current and projected levels of use were described, and this emphasized the need for vigorous action by this de-

partment and the state in securing and setting aside areas throughout the state for these purposes. Finally, specific recommendations were given for the wise use of water resources in meeting current and future needs as these are recognized today.

In conclusion, the hard, cold economic facts dictate that the preservation and management of existing natural fish and wildlife areas is the realistic approach to these "water control" fish and wildlife problems in Louisiana since extensive remedial and rehabilitation costs are virtually prohibitive. The only feasible approach to this is by the careful evaluation, study, planning and coordination for multipurpose use of any water control project. Frequently, a single project will affect detrimentally a

greater area than the whole development program of this entire department has been able to rehabilitate in the past ten years. Many people interested in these resources simply cannot visualize or recognize that many changes associated with water control projects may be completely irreversible in a short period of 25 to 50 years, or even less. To meet these needs adequately, this section needs to be properly staffed with a minimum of four highly trained technicians so as to keep abreast of the many proposed projects in their various stages of study so that adequate fish and wildlife evaluations can be made and protective measures described and implemented.

AQUATIC VEGETATION CONTROL

FRED L. MYERS
Federal-State Coordinator

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Field Supervisor

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Biologist



FRED L. MYERS

The aquatic vegetation control program as it exists today has developed as an extension of the Water Hyacinth Control program as outlined in previous Biennial Reports. It is still primarily concerned with the control of water hyacinth, although since the program has been expanded by joining the U.S. Corps of Engineers in a Federal-State cooperative program, other aquatic weeds have been brought within the scope of the program and are included in field operations as fast as methods for their effective and economical control are developed.

At the present time, in addition to water hyacinths, field operations include the treatment of water primrose, water lotus, and water lily; and, although the presently available treatments serve only to check its growth, field units working in the areas of the Federal-State Expanded Control Program treat alligator weed as is stipulated in the general contract governing operations in this phase of the general program.

The objective of the program is accomplished by spraying plants with a one-half of one percent solution of the amine salt of 2, 4-dichlorophenoxyacetic acid (one quart of acid concentrate to fifty gallons of water) which is sprayed at the rate of one gallon of concentrate (4 pounds acid equivalent) in two hundred gallons of water per acre treated.

Although maximum effect is obtained during hot weather when the plants are growing rapidly, at least in the case of the water hyacinth, spraying operations are carried on year-round whenever weather conditions permit. In the event that rain falls on the water hyacinths or lotus within three hours after they are sprayed, they must be re-sprayed because it takes approximately that amount of time for the chemical to be absorbed into the plant for killing effect. Because of the waxy surface of the plants, it is necessary to include a wetting agent in the spray solution, in the case of the water hyacinth, three ounces of a powdered detergent is added to each fifty gallons, and for the other plants, one ounce of commercial spreader-sticker is used.

During the relatively warm spring and summer

months, the hyacinth plant will die and sink within three to five weeks, depending on sunshine and atmospheric temperature. Conversely, during the colder fall and winter months, they will not die and sink as fast, sometime taking as long as ten to twelve weeks. However, best over-all results are obtained when the plants are sprayed during the colder months after the plants are withered by frost because their terminal buds are exposed, making the plant more vulnerable to the spray. Also, translocation within the plant is downward at this time of the year and causes the absorbed acid solution to be taken directly to the rhizome or heart of the plant quicker.

In areas where the water hyacinths have formed dense mats, the initial spraying is done by use of specially fabricated steel boats with an elongated sharply pointed bow, propelled by outboard motors. A compartment with a capacity of 100 gallons is built in mid-ship for containing the liquid to be sprayed. Atop this compartment is mounted the spraying equipment, consisting of a small air-cooled engine connected by belt and pulleys to a small tractor pump. This spraying unit throws a stream a distance of forty feet, with the outer ten feet fanning out for excellent coverage. The small garden-type nozzle can be regulated by the turn of a knob to form a shorter, fan-like spray stream for covering plants near the boat.

The spray unit runs continuously because it is used for pumping water from the bayou or lake into the drum for mixing each batch of spray solution. The operator merely transfers the suction hose from the drum to the bayou to obtain water for this purpose. When the drum is filled, the suction hose is then returned to the drum and spraying is resumed.

The above described operation is made possible by having a relief valve installed in the pressure line

which goes into operation automatically when the spray nozzle is closed. The use of this valve has also brought about a saving of from 20 to 30 percent in 2, 4-D use by allowing the operator of the spray nozzle to close the nozzle when changing the direction of his spray fan from one batch of plants to another separated by open water where there are no plants. He merely closes the nozzle which automatically opens the relief valve to allow the solution to recirculate to the mixing drum.

The steel boats are operated by two men, one navigating the boat with the outboard motor and the other doing the spraying from the front of the boat. Occasionally, in the case of a tight mat of hyacinths, it is necessary for the front man to cut the mat with a ditchbank blade in order to move forward. Most mats, however, can be penetrated by these steel boats, when operated by a skillful motor operator, without the use of the cutting blade.

When hyacinths occur in scattered patches and have not matted, the spraying is done from a lighter aluminum boat carrying a fifty-five gallon drum for mixing the chemical as described above. The same type of spraying equipment is used with this type of boat.

This arrangement is easily used by one man when the plants occur in scattered patches or along the fringe of a lake or stream. Under these circumstances, the power for the boat is obtained by the use of a 5½ h.p. outboard motor. Where the hyacinth plants occur in a loose mat, this type of boat is also used advantageously.

Aside from the saving in chemical used, both types of equipment bring about much saving in time and effort because of their lightness and flexibility, yet being very durable. Either type of boat and the full complement of equipment can be easily loaded and unloaded, to and from a truck, by two men when it is necessary to transport from one body of water to another, which is frequently the case.

We have fabricated another type of equipment, the truck borne unit, which has proven to be very effective in spraying hyacinths under certain conditions. This unit, with its 560 gallon tank for containing the spray solution, has been used to spray many miles of bayous and canals where the footing alongside them is firm enough to support the truck. The chemical is sprayed from this tank (mixed in the same proportion as employed in mixing for the boats) by a fire-pump which produces pressure sufficient to throw a stream 125 feet without appreciable fogging, and, in many cases is sufficient to reach completely across the stream or canal. This unit is used only in spraying tight mats that have never been sprayed, after which a mop-up operation is done with the aluminum boats.

In the late spring of 1959 the Federal Government made funds available to implement a Federal-State Combined Program for Aquatic Weed Control in the eight southeastern seaboard states from Texas to North Carolina. This program is pointed mainly toward the control and progressive eradication of water hyacinth and alligator weed, but does make provision for effort toward the control of other aquatic plants, and provision for research into the over-all problem is a facet of the program.



J. G. "Pete" DUTTON

Although this program will result in increased effort toward the control of aquatic weeds within the State of Louisiana, it has not materially increased the scope of operations of the Aquatic Vegetation Control program, and has, in fact, restricted these operations in certain areas of the state. As the program was being formulated, it was hoped that the administration could follow generally that of the other Federal Aid matching funds programs of the Fish and Game Division whereby the program would be operationally vested in the State with appropriate inspections and accounting checks by Federal personnel.

However, as the program was presented to the State, it was in the form of a matching funds program whereby the State would furnish 30 percent of the total operational funds and the Federal government would furnish 70 percent of these funds; operations for the entire program, however, are the prerogative of the U. S. Corps of Engineers who delimit areas of operations, methods of operation, and operational effort (reimbursable funds) available to the Aquatic Vegetation Control Program of the State, guaranteeing only that work up to 30 percent of the total program be allocated to the State program. Inasmuch as the State crews were required by the general contract governing the program to conform to arbitrarily assigned work areas which had been selected as "pilot operational areas" to ascertain the "best methods of obtaining the design results," changes were necessitated which interrupted work in some areas by state crews and resulted in the loss of control over the water hyacinth which had been obtained by previous operations, and also necessitated the transfer of these crews to areas away from their normal bases of operation. This shift resulted in additional operational expense being incurred in the transportation and maintenance of these crews.

Certain adjustments in the Federal-State program

are proposed at the present which will, if forthcoming, ameliorate to some extent certain of these inequities.

At present the total operational budget for the combined Federal-State program amounts to \$410,000, of which the State contributes \$123,000 and Federal contributes \$287,000. The state operational share is approximately 18 percent over and above their guaranteed participation; the remainder being applied directly to operations by the Corps of Engineers in expanding their normal hyacinth control program in maintaining the navigable waterways in the southern portion of the state.

Participation in this program has allowed the expansion of the Aquatic Vegetation Control program to include operations in the Hamburg Loop area of Bayou des Glaïses and the Bayou Têche watershed complex above U. S. Highway 190 and the addition of crew effort on water hyacinth and water lotus in Lake St. Joseph and adjacent waters.

It is anticipated that future expansion of the combined program will allow re-entry into the area of the Plaquemine waterway and infested areas west of the Atchafalaya floodway and eventual entry into the floodway itself with a greatly intensified control program.

It is with pride and a great deal of satisfaction that the accomplishments of this section for the past decade are reviewed. Although the program has never had the scope which was felt it needed for maximum effectiveness in obtaining control over the mats of hyacinths which covered many of the larger and more desirable of Louisiana's fishing waters, important gains have been made in reclaiming lakes such as Bistineau, the largest impoundment in the state, where the hyacinth infestation has been reduced to the point that in only a small portion of the lake, in the upper end, are water hyacinths in evidence. For all practical purposes Cane River in Natchitoches Parish has been cleared, as has Old River and Bayou Derbonne; all of these streams were from 60 to 90 percent covered when control operations were started. The infestation on Wallace Lake has been reduced to a few isolated pockets near the northern shoreline of the lake and the remaining surface area is open.

In the northeastern section of the State, Black Bayou Lake and Bayou de Siard in the Monroe area have been cleared of the dense mats which formerly denied use of these very productive waters.

Black, Clear and Saline Lakes in the north-central portion of the state were brought into the operations plan before the hyacinth infestation had materially reduced their usefulness and are a prime example of the benefits of fast action in the face of a threatened invasion of the purple menace.

In all cases cited, although the lakes have been returned to the fishermen and hunters of the state, a continuing maintenance patrol is necessary to assure that the gains so far made by the program are not lost by creeping encroachment of plants produced by seed which infest any area on which the water hyacinth has at any time gained a foothold. These maintenance patrols, although an essential phase of the program, tend to reduce the operational

effort available for application on primary infestations in other areas of the state.

The vast waterways of Avoyelles Parish have long been recognized as among the most valuable waters of the state for the production of game and commercial freshwater fish as well as being a prime area for waterfowl hunting. Continuing effort on the part of the operational crews have held the hyacinth in this area in check to the extent that these areas are open and usable. With the advent of the combined Federal-State program, operations in this area were expanded to include the lakes and streams within and surrounding the Bayou des Glaïses Loop near Hamburg. Continuing effort will be necessary before the waters of this area are cleared to the extent that they will be ready to be put in the maintenance phase of operations.

In this same general area, Chicot Lake and Miller's Lake have been included in field operations; Chicot is essentially a maintenance problem and the hyacinth infestation in Miller's Lake is being reduced.

Water lotus is a problem on some of the lakes of the State, particularly on Lake St. Joseph. A slight shift in operational procedures, indicated by research results, was put into effect here during the latter part of the biennium. Indications at this time, subject to confirmation during the summer of 1960, are that the lotus infestation will be materially reduced by these treatments. They are also expected to give good control of the hyacinths on this lake.

In the Florida Parishes many of the streams which are high in fish production such as the Tangipahoa River, Anite River, Natalbany River, Tickfaw River, Blood River, Colyell Bay, Bayou Barbara, Alligator Lake, and Blind River, along with streams in the Pearl River Basin have been cleared to the extent that they are in the maintenance phase of the program. In other, smaller, streams, back bays, and canals a primary infestation still exists which is receiving attention at this time from field crews.

Although gains continue to be made in the area between the Mississippi and Atchafalaya Rivers, the operations in this area were restricted during the latter part of the biennium to conform to operational orders and procedures of the Corps of Engineers in the combined Federal-State program. Operations in an area as large as this are difficult and, of necessity, diverse. Certain sections, where attention was directed some time ago, are at present in the maintenance phase, however, considerable areas of hyacinths in this area have yet to be subjected to any control operations at all.

Even with the above cited achievements in removing the water hyacinths from the streams and lakes mentioned and maintaining them in this condition, we have not, as yet, been able to see the full accomplishment of our job. There are many areas of our state in which we have been unable to work because of the lack of sufficient funds to finance a full scale program. Southwest Louisiana and the area south and east of New Orleans need attention and it is planned that systematic work will begin in these areas if and when present jobs are completed and we are able to transfer our efforts to them,

when and as additional funds are made available.

Another phase of the program, and one which is daily increasing in importance with the increased utilization of waters of the state for recreation and the great increase in numbers of boats and trailers, is that of research to provide control methods for the vast complex of aquatic weeds for which there are, at present, no suitable means of control. Foremost among these is alligator weed (*Alternanthera philoxeroides*), pondweed (*Potamogeton* sp.), and the plant group which is usually lumped together by the sportsman and cursed as "moss".

Although research effort has been curtailed to some extent during the past biennium due to a lack of personnel and the necessity of utilizing available personnel in the adaptation of field operations and the organization of the administrative procedures of the program to fit the framework of the combined federal-state program, certain advances have been made.

During the past few years, the trend has been to stabilize the waters of the state; impoundments and ring levees have been utilized for this purpose as well as low sill dams in certain sites. In this portion of the United States it is axiomatic that stabilized water is generally clear water, and it follows almost without fail that clear water in warm climates such as exists in the state, with other factors contributing, results in a heavy infestation of aquatic plants.

Extensive tests of herbicides for the control of alligator weed, both within the State of Louisiana and throughout the Southeastern United States, have, so far, yielded no satisfactory control method for this

plant which is potentially as troublesome as the water hyacinth.

Another troublesome weed, pondweed, is appearing in more and more of Louisiana's prime fishing waters. This is one of the plants which is commonly called moss. In actuality, several species of *Potamogeton* are found in the state and from preliminary investigations there appears to be differences in response to chemicals by several individual species. If this proves to be the case, determining methods for their control will be much more complex than has been anticipated in the past. Preliminary tests during the biennium indicate that there is a possibility of obtaining a degree of control of pondweed by utilizing pelleted formulations of certain herbicides. A great deal of work remains to be done, however, both in determining the activity of the specific chemicals and their effectiveness as pelleted materials.

Other of the "moss" plants which are present and deny access to fishing and hunting waters of the state are coontail (*Ceratophyllum demersum*), waterweed (*Elodea densa*), parrot feather (*Myriophyllum brasiliense*), water milfoil (*M. heterophyllum*), fanwort (*Cabomba caroliniana*), and bladderwort (*Utricularia* sp.), all of which are problems in from one to several of the major fishing waters.

An increase in research effort is needed to devise methods of control for these plants to enable the Aquatic Vegetation Control program to stop the creeping encroachment of these plants; to fulfill its mission of returning the weed clogged waters of the state to the fishermen, hunters, and boatmen, and of maintaining these waters in condition to facilitate their total utilization.

REFUGES & WILDLIFE DEVELOPMENT AREAS

CHICAGO MILLS REFUGE

DEWEY WILLS
District Game Supervisor

C. T. WILLIAMS
Game Biologist

The Chicago Mills Refuge is composed of parts of the old Singer Game Refuge and Ayers Wild Life Refuge in Madison and Tensas Parishes and includes approximately 50,700 acres of mixed bottomland hardwood habitat. Of the total acreage in the refuge, 49,200 acres lie within Madison Parish and 1,500 acres within Tensas Parish.

During the last two years the main work program for this area comprised deer trapping, boundary line and road maintenance, and the construction of new jeep roads to aid deer trapping operations.

Deer trapping operations are carried out yearly within the north-central portions of the refuge and will be discussed in the Pittman-Robertson report.

Maintenance and construction work performed during the last 2 years are as following:

1. Boundary line
 - a. 60 miles of old line were reworked
 - b. 58 miles of old line were repainted
 - c. 1700 boundary markers were replaced
2. Roads
 - a. 25 miles of old jeep roads were reworked
 - b. 18 miles of new jeep roads were constructed
3. Salt licks
 - a. 4 old salt licks were resalted
4. Entrance markers
 - a. 6 new entrance signs were erected

CHENIERE LAKE PUBLIC HUNTING AND FISHING AREA

JOE L. HERRING
District Game Supervisor

CHARLES R. "Chili" BAUR
Biological Aide

Cheniere Lake is located in the central portion of Ouachita Parish approximately three miles south of West Monroe. This lake has a medium growth of cut-over cypress, gum and other bottomland hardwood types. Waters on this area were lowered during 1956 for the purpose of harvesting timber; the Commission took advantage of this by planting waterfowl foods. The lake was lowered to the 57.5 foot

M. G. L. contour. After this drop the lake was approximately 1,200 surface acres in size. Dropping the lake to this level exposed many good areas suitable for waterfowl development.

Land area for Cheniere Lake was acquired from the Dixie Lumber Company by the Louisiana Wild Life and Fisheries Commission for game and fish management purposes on a long-term lease without fee. In November 1959 the Ouachita Parish Police Jury purchased Cheniere Lake from the Dixie Lumber Company.

One hundred and fifty pounds of (*Eleocharis quadrangulata*) squarestem spikerush, and (*Scirpus americanus*) threesquare rush seed, were received from South Carolina for planting on Cheniere Lake.

Eleocharis quadrangulata is a squarestem spike-rush and is an important fresh-marsh waterfowl food of the Atlantic and Gulf Coast Plain. It is a rather robust plant with larger seeds than most other spikerushes and with four-angled (or rarely three-angled) stems 2 to 3½ feet high. This species frequently produces small white tubers with a texture similar to that of the potato, and these are also of some value as a waterfowl food. The plant generally grows in water less than 18 inches deep, but it will withstand total emergence for considerable periods if the soil remains wet.

Scirpus americanus or common three-square rush is a good waterfowl food throughout the United States. This rush grows commonly on sandy soils on lake margins and often along streams or in marshes; sometimes emergent from water a foot or more deep. It grows in either freshwater areas or in brackish or moderately alkaline places.

Three areas were selected for planting. Depth of water on these areas varied from six inches to one foot. Seed were planted broadcast on the water surface area. Reason for planting in this manner was that the water would be off these flats within a matter of days; thus, leaving the seed on ridges or high areas with good seedbeds.

These areas propagated well on into 1958. There was, for some reason, a decline in the volume of both plants growing in 1959. This may be due to constant high water held over the plants.

For the past two seasons Cheniere Lake has had fair waterfowl hunting. Species killed were mostly mallards and woodducks. Fishing has been good on the Lake—mostly bass and bream with some crappie and catfishing.

TERZIA GAME REFUGE

JOE L. HERRING
District Game Supervisor

GUY CAMPBELL
Biological Aide

The Terzia Refuge is located approximately five miles northwest of Bastrop, Louisiana, in the central portion of Morehouse Parish. It comprises an area of approximately 46,000 acres of mixed hardwood timber. The topography is a gentle rolling terrain. Through cooperation with Crossett Lumber Company, this area has been acquired by

the State for refuge purposes on a long-term lease without fee.

The area is supporting a good deer herd and a controlled deer hunt has been recommended for the area. Condition of deer in this area is not as good as deer from the hill parishes across the river. There is much competition on browse food plants, for cattle and hogs are on the Terzia Refuge.

This area, being one of the oldest Refuges in the State, has not given sportsmen its full capabilities. Other areas of similar size, and smaller, have produced good still hunting for deer in as few as five years. Thus, with proper management and understanding, this area could produce very good deer hunting for the sportsmen who are footing the bill.

Through biological research it has been found that it is better to hunt game species to some degree so that a more balanced and healthier population may be had. In short this is referred to as "harvesting the surplus". Some sportsmen are of the opinion that squirrels, deer, and other animals will multiply in a refuge and overflow to the surrounding areas. Through trapping and tagging of game animals, it has been noted that the home range is usually of a very limited radius so sportsmen are only benefiting from the very edge of such a refuge. Many animals are born, live, and die within the boundaries that sportsmen never see. Instead of "harvesting the surplus", this may be referred to as "wasting the surplus".

There has been no development work for game propagation purposes on the Terzia Area during this period. Supplementary food plots developed in 1956 have not been maintained except for mowing.

The area is supporting good turkey flocks. Counts are made each spring on the area and from these counts it is noted that the turkey population has been on a good increase. This increase has also been over most of the northern portion of Morehouse Parish. Turkey populations have risen to a huntable population; thus, the first season was held in Morehouse Parish north and east of the refuge in April 1959.

One of the best turkey hatches that we have had in recent years was experienced during the spring of 1959. Personnel of the Louisiana Wild Life and Fisheries Commission, in making field observations, have noted broods running in size from seven to thirteen poults. The number of poults to the brood is not high but about average. Of more importance is the fact that more hens are leading broods.

Boundaries have been maintained with white painted lines and boundary signs. Approximately thirty-seven (37) miles of boundary was repainted during this period. Six large entrance signs were placed, one each, on six main entrances to the area.

Enforcement personnel along with Game and Fish personnel have patrolled the area against poachers. Refuge Supervisor Fred Freeland retired from the Commission during this period after some twenty years of service.

DISTRICT TWO QUAIL DEVELOPMENT AREA

JOE L. HERRING
District Game Supervisor

GUY CAMPBELL
Biological Aide

Quail Development Areas for District II are located approximately one mile east of Downs ville, Louisiana, in Union Parish.

Two areas, one "No Hunting", and the second "Hunting Permitted with Permission from the Landowner", were set up to study the effects of hunting on a quail population and quail utilization of food plantings. The project was initiated in 1955 and will be completed in 1960.

Topography of both areas is rolling to hilly with ponds or spring-fed streams running through them. Soil types are primarily of the sandy and sandy loam groups.

A total of 2,700 acres of land was leased for development. The "No Hunting" area consists of 1,500 acres and the "Hunting" area is 1,200 acres in size. Twelve supplementary food plots were established on each area for a total of 24 plots; each is one-half acre in size.

Food plots were fenced by using three foot hog wire at the base and two strands of barb wire on top, making the areas hog and cattle proof.

Each year the food plots were planted in part to wheat, common lespedeza, soybeans, brown top millet, milo, sunflower, field peas, oats, vetch, and lespedeza bi-color. Plots were fertilized at the rate of 400 pounds of 8-8-8 per acre.

Quail whistle counts have been made in the spring of each year since 1956 to assist in giving an index for quail populations on each area. Ten count stations were selected on the "No Hunting" area, and eight stations on the "Hunting" area. These stations were selected at distances of one-half to three-fourths miles apart and gave each area complete coverage.

Whistle counts have been made each spring on the two areas simultaneously by District II personnel. A stop of ten minutes duration was made at each station, with the number of quail and total number of calls being recorded. There has been no noticeable difference in quail populations on either area since the initiation of the project. A bird-dog census of each area was made in 1955; another dog census will be made in the early spring of 1960 as a check against the whistle counts and the original dog count.

Other game species noted utilizing the food plots have been doves and rabbits.

LAFOURCHE PUBLIC SHOOTING AREA

JOE L. HERRING
District Game Supervisor

CHARLES R. "Chili" BAUR
Biological Aide

The Lafourche Public Shooting Area is located approximately ten (10) miles west of Rayville on



U.S. Highway 80 in Richland Parish. Primary interest in this area is waterfowl shooting. The area is composed of 1,875 acres of bottomland hardwoods. At one time this area was flooded naturally and held water for excellent waterfowl shooting. With the Lafourche drainage program, this area has not been capable of holding water by natural means.

Biologist John E. Frey, formerly with the River Basin Section of the Louisiana Wild Life and Fisheries Commission made a study of the Lafourche swamp area before and after drainage and its effects on wildlife. Mr. Frey's report in part is as follows: "Prior to the Corps of Engineers drainage project (before 1949) on Bayou Lafourche, Lafourche swamp was subject to an annual overflow for a period of about three months during the late winter and early spring. This overflow situation provided an excellent habitat for waterfowl, fur bearers, and fish. These flooded mast-producing bottom lands were highly utilized by mallards and wood ducks. Commercial fishing was also very good in the Lafourche swamp area. Schools of buffalo and catfish moved up Bayou Lafourche from the Boeuf River to spawn in the flooded flats and sloughs. Sport fishing for bass, white perch, and bream was reported to have been good in the numerous small lakes and potholes in Lafourche swamp.

"Lafourche swamp and Bayou Lafourche was once one of the best fur producing areas in northern Louisiana, primarily due to the annual overflow of water, lasting about three months, from Bayou Lafourche into the poorly drained Lafourche swamp region. This overflow situation has almost completely been eliminated as a result of the Corps of Engineers project on Bayou Lafourche (from 1949-

1953) which, in turn, has eliminated the excellent fur bearer habitat once present in Lafourche swamp. This also has resulted in a steady decline in the catch of mink, coon, otter, skunk, o'possum, and fox since the 1950-51 trapping season.

"Trapping and fur catch had decreased to such a low point in the 1955-56 season that one fur buyer in Monroe stopped buying furs completely. The catch of mink decreased from a high of 19,891 skins in 1950-51 to a low of 1,760 skins during the 1955-56 season. The income to trappers from the sale of mink pelts, during the same period, has also decreased from a high of \$318,256 to a low of \$28,160. The catch of raccoon has also decreased from a high of 48,928 skins during the 1946-47 season to a low of 8,311 skins in the 1955-56 trapping season. The income to trappers from the sale of raccoon pelts, therefore, decreased from a high of \$61,160 to a low of \$10,388 during the above period."

A general decline in other fur bearers including otter, skunk, o'possum and fox was experienced during this same period.

"The Lafourche swamp was once, prior to drainage, one of the best duck hunting areas in northeastern Louisiana. The annual overflow created an ideal habitat for mallards and woodducks through the flooding of the mast producing timber in this area, and thus provided excellent duck hunting for the local people and many other sportsmen from the Monroe area. The duck hunters interviewed from Ouachita, Richland, and Caldwell Parishes stated, without exception, that duck hunting in Lafourche swamp was once very good, and easy limit kills were made per hunt. Duck hunting today in Lafourche swamp is non-existent. The drainage of Lafourche swamp (1949-53) has eliminated the waterfowl habitat in this area, and resulted in a complete loss of the duck hunting resource."

Since this drainage, the Lafourche Public Shooting Area has been established with the cooperation of Richland Parish Farm Bureau, Richland Parish Police Jury, Richland Parish Wild Life Federation, Morehouse Parish Police Jury and the Ouachita Parish Wild Life Federation. These organizations and official bodies worked with the Louisiana Wild Life and Fisheries Commission in leasing some 1,875 acres of bottom land hardwood from Union Producing Company for the purpose of flooding during the winter months. Flooding such areas during the winter months and releasing the water in early spring is referred to as "Green Timber Reservoirs" as the flooding does not hinder growth of timber but helps.

With permission of the landowners on a long-term lease basis without fee the Louisiana Wild Life and Fisheries Commission is reflooding the area during the waterfowl seasons by means of water control structures. In 1955 the Commission blocked the spoil gaps on the west side by use of their D-7 dozer and American dragline. By doing this it was possible to flood the 1,875 acres of land. Commission personnel then installed two 30-inch pipes with water control structures through the levees.

During the 1955 and 1956 waterfowl seasons the Commission depended on rainwater to fill the area. Depending on this source of water, the area was

not assured of filling until the later part of the season and possibly not then; thus, hunters were not receiving the full benefit of this area. In 1957 the Louisiana Department of Public Works constructed a water control structure on Irwin Lake with a canal from this point to Little Lake Lafourche to Crew Lake and on into the Public Shooting Area. By using Irwin Lake as a source of water supply the Louisiana Wild Life and Fisheries Commission is now in position to fill the area prior to waterfowl seasons. The water can then be released after the waterfowl season is completed, not injuring and damaging the forest species.

With construction of the water control structures in 1957 this area has been very good for mallard and woodduck hunting. Water levels are held low enough so that hunters may wade the area in hip boots or use pirogues.

The Louisiana Department of Highways graded and topped the road on the west spoil bank with a four inch thickness of pit-run gravel. Length of this road which leads from Highway 80 south into the Public Shooting Area is one mile. Improving this road will assist in getting waterfowl hunters in the more remote part of the Shooting Area. This road will also benefit other hunters and fishermen beside those seeking waterfowl.

A total of thirty (30) native Louisiana deer from the Red Dirt Game Management Area and Madison Parish were released south of this area in February and April of 1955. The first deer hunt was held on this area December 1-7, 1959, with good results. Deer killed were in very good condition and sporting good racks.

FISHER CREEK PUBLIC HUNTING AND FISHING AREA

JOE L. HERRING
District Game Supervisor

GUY CAMPBELL
Biological Aide

Fisher Creek Public Hunting and Fishing Area is located three miles west of Soudheimer, Louisiana, in East Carroll Parish. Land for this area has been secured from the H. L. Hunt Oil Company and East Carroll Parish School Board. Engineering assistance for the construction of this area was given by the Louisiana Department of Public Works.

To construct this area a small earthen dam was placed at each end of Fisher Creek Brake. An overflow spillway was made on the western side of the area. The lake area has cypress and bottom land hardwoods dispersed throughout it. This hunting and fishing area is approximately 500 surface acres of water in size.

The Fisher Creek Public Hunting and Fishing Area has produced fair mallard and woodduck hunting and good fishing for the 1958 and 1959 seasons. Commercial trappers living around the area have stated that their catches have been bigger around the area since reflooding of the old brake.

SHILOH CREEK PUBLIC SHOOTING AREA

JOE L. HERRING
District Game Supervisor
CHARLES R. "Chili" BAUR
Biological Aide

Shiloh Creek Public Shooting Area was constructed for the purpose of a waterfowl hunting area. Its location is approximately five (5) miles west of Vaughn, Louisiana, and borders the Terzia Refuge to the north. It comprises approximately 1,200 surface acres of water area when full.

Through cooperation with the landowner, Crossett Lumber Company, this area has been acquired by the State for game management purposes on a long-term lease without fee.

A dam 415 feet in length was constructed across Shiloh Creek to make this area. The dam is five to seven feet in height with a fifteen foot crown. A pipe, thirty (30) inches in diameter and twenty (20) feet in length, with a control gate, was installed so that water levels may be regulated.

Rainwater is caught on the area prior to waterfowl season and released after the closing date. By letting water off before spring growth starts timber is not injured. Such an area is referred to as a "green timber reservoir".

Shiloh Creek Public Shooting Area has produced some good mallard and woodduck shooting. Commission personnel are working on a permanent source of water so that the area may be flooded or water let in as the need arises. Plans are also being made to increase the size of this area.

Fishing has been very good in early spring below the outlet pipe from Shiloh Creek Public Shooting Area. Fishermen have utilized Shiloh Creek from the shooting area to the point where water flows into the Ouachita River.

FINCH BAYOU PUBLIC HUNTING AND FISHING AREA

JOE L. HERRING
District Game Supervisor
CHARLES R. "Chili" BAUR
Biological Aide

Finch Bayou Public Hunting and Fishing Area was constructed in 1956 on Finch Bayou in Union Parish. The area is located approximately four (4) miles east of Haile, Louisiana, on the Ouachita River.

In constructing this area a dam was built at the northern end of Finch Bayou and the present dam on Harrell Lake was raised. A water control structure was placed on the Harrell Lake end for water fluctuation purposes. All construction was by the Louisiana Department of Public Works. Agencies helpful in establishing this area were the Marion Civic Club and Union Parish Police Jury. Land for this area was leased to the Louisiana Wild Life and Fisheries Commission on a long-term lease by the following companies: (1) Mineral Lands, Inc., (2) Columbia Carbon, (3) Olin Gas Transmission Company, (4) Olin Mathieson Chemical Corporation, and (5) Union Producing Company.



Finch Bayou Public Hunting and Fishing Area is approximately 600 surface acres in size. Thus far, a water fluctuation program has been in effect and has not killed the timber. During the spring high waters on the Ouachita River, water floods into this area, thus "flushing" out and giving a stocking effect for this area each year. During 1958 and 1959 the area produced very good bream and bass fishing. Fair waterfowl hunting was experienced on the western portion of the area. Permanent type duck blinds are not permitted on the area; thus, waterfowl hunters blind up in their boats or wade the shallow areas.

A concession stand and boat rental area has been constructed by the Union Parish Police Jury and leased out under the supervision of the Louisiana Wild Life and Fisheries Commission.

PREDATOR CONTROL

THOMAS E. HARRIS

Supervisor

The predator control program is set up as a section under direction of the Chief of the Fish and Game Division. Its practice has been aimed at the control and prevention of losses, through predation, of livestock, poultry, other domestic and/or wild animals important to the economy, and where intensive game management developments are underway.

During the past biennium, our section has also concerned itself with the control and eradication of rabies vectors, predicated by the fact that many wild and domestic mammals are primary carriers of this deadly virus. By employing various trapping techniques, we can reduce the number of susceptible animals present in an epidemic area of the State, thereby imposing a check on the spread of this infectious disease.

At the writing of this report the wolf population is rapidly increasing, especially in northwestern

Louisiana. It has also begun to spread into eastern and southern sections of the State. The process by which they spread is as follows: A pair of adult wolves will select an area for their home range. They will establish a territory and raise a litter of pups; usually from three to seven in Louisiana. The original pair will spend the remainder of their life-span within this previously established home range. However, the pups, when they are old enough to breed, seek out a new area, locate a mate, and follow the behavior exhibited by their parents. As this species of wolf is much more prolific than his cousin, the timber wolf, they soon begin to spread into areas capable of meeting and supplying their primary needs for existence and reproduction. The species of wolf we are now encountering is a migrant from east Texas and south Arkansas.

The fox population is again on the increase after their numbers were reduced by a recurrence of rabies during the past three years. Bobcats are becoming more numerous in northeast and south-central Louisiana. However, their posing a severe threat to wildlife and farm animals in these areas is not too apparent at this writing.

In considering the effect of each of these species mentioned, I would submit the following opinion:

1. The wolves are detrimental to livestock and poultry more than anything else, because this type of wolf seems to prefer living close to civilization, principally along the Red River Valley, where we trapped twenty-three in one three-mile area in Red River Parish.
2. The fox has caused the most trouble by spreading rabies among other foxes, dogs and livestock. Also, numerous people have been bitten by rabid foxes in the past few years.

Following is a list of fifty-two positive cases of rabies in Louisiana as diagnosed by the State Health Department:

Foxes—1958—5	Dogs—1959—10
(all in December)	Cows—1959—2
Dogs—1958—1	Skunk—1959—1
Foxes—1959—33	

This is only the rabid animals that contacted people, principally in Claiborne, Bienville, and Webster Parishes. The best prevention for the spread of rabies in these areas would be a dog registration program requiring inoculations and an effort aimed at controlling the fox population on the periphery of epidemic areas.

3. The Bobcats are the best hunters and are destructive to wild turkeys, deer and other game species of similar habits and habitat requirements.

During this biennial, the predator control section trapped the following:

	1958	1959	Total
Skunks	1143	951	2094
Wolves	50	60	110
Housecats	513	453	966
Foxes	784	1009	1793
Bobcats	220	199	419
Miscellaneous*	3531	2556	5987
Total, all predators—	11,369		

*Oppossoms, raccoons, wild dogs, etc.

ENGINEERING AND CONSTRUCTION

WILLIAM E. ACKLEN
Engineer

A continuous maintenance program is necessary to keep the Division's properties in a good state of repair. Some examples of these projects consist of making the necessary repairs, scraping and repainting the outside of the buildings, replacing all the screens, and repainting the inside of the building occupied by the Pittman-Robertson Section of the Fish and Game Division at the District VII headquarters. The residence occupied by the caretaker was also remodeled and repainted.

There were repairs made on the residence, located on the Commission's property at Allen Dam in Natchitoches Parish, which consisted of repairing and enclosing a porch, redecorating the kitchen and dining room, repairing the screens, and rebuilding some of the fences on the property.

The residence at the Beechwood Fish Hatchery was releveled and new foundations were added. The building was cleaned and repainted and the roof was repaired. There was a concrete retaining wall built around the yard, fill dirt hauled and placed in the yard, which was eroded badly. A concrete floor was poured in the warehouse occupied by the Fisheries Section. Repairs were made to the bunk house.

The maintenance crews under the Fish and Game Division of the Wild Life and Fisheries Commission also constructed an equipment storage building to house state owned equipment, used by the Pittman-Robertson Section of the Fish and Game Division at the District IV headquarters, located in Ferriday, Louisiana.

An office building was constructed on state land at Pineville consisting of six offices to be utilized by personnel from the Pittman-Robertson, Fisheries, and Predator Control Sections, and the Enforcement Division. This group made some extensive repairs on the public hunting camps and the main clubhouse located on the Pass-a-Loutre Public Hunting Area. Parts of the old Quail Hatchery Building in Baton Rouge were remodeled for office and laboratory use by the Engineering, Hyacinth Control and Fisheries Sections.

These crews cleared the grounds, rebuilt the fences, and made minor repairs to the camp house located on the Grassy Lake Public Hunting Area. Concrete water control structures were built in the levees of the impoundments of the Bodcau Public Hunting Area.

They helped survey all the boundary lines and set boundary markers on the Wisner Public Hunting Area in Lafourche Parish and the Biloxi Marsh Area in St. Bernard Parish. They also helped make the ground survey on the Soda Lake area in Caddo Parish.

At the LaCombe Fish Hatchery, the carpenter crews repaired the main water lines from the exist-

ing well to the fish pond. Also, they repaired some concrete lined ditches.

One $\frac{3}{4}$ cubic yard dragline was used continuously throughout this biennium, building access and approach roads, installing drainage culverts, and constructing levees for impoundments for the Bodcau Public Shooting Area in Bossier Parish. Another $\frac{3}{4}$ cubic yard dragline was assigned to the Wisner Public Hunting Area for the purpose of building earthen fills and wooden water control structures.

The D-6 and the D-7 Caterpillar bulldozers were utilized in clearing right-of-ways for the building of roads and assisting the draglines in making fill dirt available for the construction of roads and levees in the Bodcau Public Hunting Area. The bulldozers were also used for clearing the boundary lines on the various Game Management Areas throughout the state, and clearing boat roads for fishing, hunting, and recreational purposes on some of the various lakes and impoundments, which exist and are being constructed in the state of Louisiana. The bulldozers were also used for the clearing and discing of various food plots on the Game Management Areas. A new impoundment area was constructed in the low lying area adjacent to Black Lake in Natchitoches Parish. The bulldozers rebuilt the access roads in the Union Parish Game Management Area in Union Parish.

The D-7 dozer was utilized in the Lafourche Public Shooting Area for the purpose of building a new access road on top of the old spoil bank which was deposited from the dredging of the Bayou Lafourche drainage canal in Richland Parish. Repairs were made to the levees which impound the water for this Public Shooting Area.

Work began on the Wisner Public Hunting and Fishing Area with the establishment of boundary lines of the area on the latest available quadrangle maps by using a land description based on townships, ranges, sections, etc. With this boundary in mind, numerous field inspection trips were made throughout the area exploring the bayous, lakes, canals, and their tributaries to determine suitable locations for the construction of wooden or earthen low-sill dams. These dams were to afford a partial control of tidal flow and water levels, and thereby reduce salt water intrusion into marsh and pond areas. Soil borings were taken to determine the location of the dam sites along each tributary. At each of these sites, a representative cross-section was taken by use of a sounding rod and tape. This information was used in the design of the appropriate wooden or earthen dam to be located there.

Plans for the structures were devised and drawn by this office through consultation with and the co-operation of a private land developing company, which had pioneered some of the marsh land reclamation techniques. A bill of material was calculated for each individual wooden structure according to the structure length required to span the tributary at the prescribed site.

Individual maps were compiled by this office for each currently active game management area in Louisiana. The basic topography for the maps was taken from the latest issues of quadrangle maps appropriate to the areas. Area boundaries were super-

imposed on this topography from written description or from previous, reliable maps. The map was made in an ink line tracing form from which metal plates were etched to afford an economical reproduction for purposes of distribution to public hunters as they registered for controlled hunts in the game management areas.

Numerous maps and graphs were made concerning technological data gathered by the Dingell-Johnson project F-1-R that was to be included in various reports. These maps and graphs were made in reproducible ink line plates.

Other maps that were made include a deer season map depicting open season areas bounded by highways, streams, or other permanent land marks. This map was reproduced in pamphlet form listing season duration and land mark boundaries for the respective areas.

Through consultation with several barge building agencies, this office designed construction plans for

a spud barge to be used in reclamation work in the Wisner and Biloxi Public Hunting and Fishing Areas. The barge was designed to carry a three-quarter cubic yard dragline machine, air compressor, facilities for pneumatic drills and tools, a small overnight or storage cabin and an extra clam-shell or drag bucket.

Plans were designed and completed for the construction of the Fish and Game District III office building located near Pineville, Louisiana. Plans were also completed for additional water control structures to be incorporated in the Bodcau Public Shooting Area impoundment system. Numerous other smaller projects were completed such as sketches of deer dental age characteristics, plan of acorn trap, calculations of acreages on proposed impoundments, setting construction stakes for water control structures and draw-down kettles for fish hatchery ponds, etc.

FISHERIES SECTION

HARRY E. SCHAFER

Supervisor

and

DINGELL-JOHNSON

Coordinator

THE FISHERIES SECTION during the last biennium was static as far as the number of technical personnel employed. There were still only seven fisheries biologists carrying on research, management, and fish propagation. With the present work load and the important projects that should be getting attention, the section should have at least four more fisheries biologists. The monies received from the federal government under the Dingell-Johnson program were several thousand dollars less during this biennium as compared to the previous two years. This was so even though the taxes collected by the federal government on fishing tackle had substantially increased. The explanation for Louisiana's decrease in funds is two-fold: (1) a decrease in the number of fishing licenses sold in Louisiana and (2) the admission of Alaska as a state.

However, in spite of the static number of personnel and the decrease in funds, the amount of work that was accomplished increased. Personnel of the pond project checked even a greater number of ponds and the three fish hatcheries produced enough fish to stock all waters that needed stocking. This was accomplished even though two of the hatcheries were undergoing complete renovation, which should be completed sometime during 1960. A new species of fish was put into one of the ponds at the Lacombe Hatchery for observation. It was the tropical fish, Talapia. This fish was being checked as possible biological control of submerged aquatic plants. A report will be prepared when this experiment is completed.

The personnel also made a survey of the feasibility of building an artificial reef in the Gulf, which would concentrate fish populations so that they could be harvested by the sportsmen. The fish populations around the offshore oil rigs were checked using scuba (self-contained underwater breathing apparatus) equipment to ascertain, if possible, the cause of why fish are attracted to the rigs. The personnel also acted as judges, officials, or experts at several fishing rodeos. They attended meetings, gave talks to various sportsmen and civic groups, and performed the administrative duties that go along with these research, management, and educational projects.

The following are reports of the fisheries projects that were active during the biennial.



HARRY SCHAFER

FISH AND LAKE MANAGEMENT

Donald W. Geagan
Project Leader

Lloyd Posey
Assistant Project Leader

This project is charged with a dual responsibility. This includes both research, for the purpose of solving local fishing problems, and management which is the application of procedures in a program of improving fishing for the sports fishermen of Louisiana.

The personnel of this project work closely with local citizens, clubs, local governing bodies, and sportsmen's organizations in evaluating and managing local fishing problems. This includes the answering of requests from such groups as to why fishing success has declined in specific areas. The answering of such requests calls for the determining of the cause of the problem along with a recommended management program.

The following is a report of the work conducted by this project during the past biennial:

Cane River Lake; Natchitoches Parish

This body of water was totally poisoned in 1955 (See Biennial Report 1954-55). During 1958 and 1959 fish population samples were collected by means of rotenone samples during the summer months. Additional population composition samples were collected by means of seine hauls.

Due to the development of a bullhead and carp problem, extensive fishing by project personnel was conducted using trammel and gill nets along with hoop net series. The information from these catches

furnished additional information as to the fish production in this lake.

In the fall of both 1958 and 1959 a selective poisoning project was conducted for the control of threadfin and gizzard shad. This project will be repeated again in 1960 to complete the three year pro-



Fishery personnel applying rotenone during selective poisoning project on Cane River Lake.



Shad killed in selective poisoning on Cane River Lake

gram. In order to facilitate this selective poisoning project and at the same time aid in the control of small sunfish, a 3 to 4½ foot lowering of the water level was conducted in 1958 and 1959.

Black Bayou Lake; Caddo Parish

The water level of this lake was raised four feet in 1954. This project is conducted for the purpose of evaluating the effects of this increase on the lake's fish population. Rotenone fish population samples have been collected prior to the water level



DONALD W. GEAGAN

raising and annually since then. These samples have been collected at the same five one-acre sampling sites each year. To date several changes have been noted in the fish population including a considerable increase of gizzard shad.

In addition, an annual check was conducted on the aquatic vegetation in Black Bayou Lake. This facet of the project was to determine what changes have occurred in the aquatic vegetation problem which was the primary reason for having the lake's water level raised.

This project will be continued through the next biennial.

Caddo Lake; Caddo Parish

This large shallow impoundment has been one of the lowest producers in pounds of fish per acre in Louisiana as indicated by rotenone samples. This project included the taking of six one-acre rotenone samples annually from the same sampling locations since 1954. The 1958 and 1959 sampling was conducted in conjunction with Dingell-Johnson Federal Aid Project F-6-R.

The purpose of this study is to evaluate the changes of the lake's fish population, total production, species composition, and to attempt to correlate any such changes with the alteration of the environment.

This project will be terminated with the collecting of samples in 1960.

Syres Lake; Richland Parish

Syres Lake is a nine-acre lake located near Mangham, Louisiana. Following the collection of fish population samples in 1957, it was recommended that the lake be totally poisoned and restocked as the fish population of 309 pounds per

acre was composed of 93 per cent undesirable species.

The cost of the chemical necessary for this project was borne by the Lions Club of Mangham. The lake was poisoned in October of 1958 and restocked with game species.

Patterson Borrow Pits; St. Mary Parish

These borrow pits are 59 acres in surface area. From the results of the fish population samples collected in 1956 and 1958, it was recommended



Lloyd Posey and Don Geagan, Fishery Biologists, preparing lake management plans for several Louisiana lakes.

that a selective poisoning project be undertaken for the control of threadfin and gizzard shad population. These two species composed 85 per cent of the total production of 429 pounds of fish per acre as indicated from rotenone samples.

The lake was treated in October of 1958 with 14.8 gallons of 2.5 synergized emulsified rotenone giving a concentration of 0.115 p.p.m. A heavy kill of both species of shad was attained.

Krotz Springs Borrow Pits; St. Landry Parish

Three borrow pits totaling twenty-eight acres were selective-poisoned in October 1958. This was done as a management project for control of the large gizzard shad production as indicated by the 1957 samples. The rotenone used in this project was purchased by the St. Landry Bank and Trust Company, Opelousas, Louisiana.

Bayou De Siard; Ouachita Parish

Fish population samples collected in 1957 indicated that this body of water contained a heavy population of threadfin and gizzard shad. In the fall of that year (See 1956-57 Biennial Report), a three year program of selective-poisoning was begun. This program has now been completed and the results will be evaluated during the next biennial as a close surveillance will be maintained on the fish population of this lake. This project is considered of extreme importance since it is the first of its kind completed on a large body of water in Louisiana. To date the results as indicated from local sportsmen's fishing success and from sampling procedures appear to be very satisfactory.

The chemical used in this project was purchased by the citizens in the vicinity of Monroe, Louisiana.

Audubon Park Lagoon; Orleans Parish

This lagoon was selective-poisoned for gizzard shad in 1958 and 1959 for the second and third application. The first application in 1957 was not considered a success due to the large number of shad still caught in seine samples following that application of rotenone. However, samples taken after the 1958 treatment indicated a very successful kill. The 1959 operation has not as yet been evaluated. This work will be continued through the next biennial.

From the original samples, it was determined that no natural reproduction of largemouth bass occurs in this lagoon and that only bass over two pounds were present. This lack of spawning success was attributed to the easy accessibility of all shoal areas to disturbances from people utilizing the park's facilities. In order to compensate for this, the lagoon has been stocked annually with bass fingerlings from the Beechwood Fish Hatchery. The success of this procedure has been indicated by the collection of yearling fish in samples taken in 1959.

Bayou Lacombe; St. Tammany Parish

This study included a complete ecological survey of Bayou Lacombe. This bayou was originally surveyed by Dr. George Bick, Tulane University in 1951. In 1952, the stream was dredged to expedite drainage. The study by Tulane University was continued for a short period after dredging. The purpose of the study in 1957-58 was to determine the degree of recovery which the bayou had undergone as a suitable habitat for organisms which had previously been abundant but had virtually disappeared following the dredging. The information obtained was valuable in that it illustrated the effects of dredging on habitat and in turn on aquatic life.

The study showed that after five years the chemical and physical characteristics of the bayou more closely resembled those immediately following the dredging than those prior to the dredging. As for the fauna, a large number of the types of organisms present prior to the disturbance, but absent immediately following it, have returned. However, certain invertebrates, such as Plecoptera and Megaloptera, which require specific environmental conditions have either not returned, as with the former, or they are present in limited numbers, as with the latter, indicating the lasting restrictions imposed on the stream's fauna.

Coastal Water Chemical Survey

Water samples are collected periodically from permanent stations in Lake Pontchartrain, Lake Borgne and the Rigolets. Samples are collected at each station from the bottom and from three foot depths. Field analysis of the samples are returned to the New Orleans laboratory for analysis of chlorides, salinity and turbidity.

Also, as an extension of this project, samples are collected at a series of stations from Lake Borgne out to Chandeleur Islands. These samples are collected quarterly.

The purpose of this project has been to record the seasonal chemical and physical changes which occur in Louisiana coastal waters. This information

is valuable as a correlation with fish and shellfish movements, and to develop a norm from which natural or unnatural deviations may be measured.

Cypremort Point Study; Iberia Parish

This study was initiated in July 1959. Limited work has been done to date because of delays in obtaining adequate equipment. The purpose of the project is to evaluate the area's utilization by marine game fish for spawning, with special emphasis on speckled trout. Work done since the start of the project includes the collection of trawl samples, trammel net samples, plankton samples, and water samples. Water samples, analyzed in the field for



Redfish taken with trammel net at Cypremort Point.

pH, free CO², temperature and alkalinity and portions, were returned to the New Orleans laboratory for analysis for chlorides, salinity and turbidity.

Since the recent arrival of adequate equipment, the work on the project will be intensified with particular reference to netting studies, gonad studies, and plankton sampling.

Holloway's Pond; Tangipahoa Parish

This pond was selectively treated with rotenone for the control of threadfin and gizzard shad in October 1958. This program was based upon the results of fish population sampling collected in 1957. At that time the shad population consisted of 97 pounds per acre. The results of the treatment were considered successful. The chemical used was purchased by citizens of Anite, Louisiana.

Chatam Lake; Jackson Parish

This lake was drained to facilitate construction work on the spillway. From the results of fish population samples collected in the remaining ten acres of water, it was recommended that this area be totally poisoned and restocked. This project was carried out in the fall of 1959 and the area was restocked.

The rotenone used in this job was purchased by citizens of Chatam, Louisiana.

Fish Population Sampling

In addition to the above projects, sampling was performed at the locations listed below. This sampling was made either by netting or rotenone methods, and the results and recommendations were forwarded to those parties requesting the studies.

Body of Water	Parish	Rotenone	Netting
Anacoco Lake	Vernon	*	
Bonnet Carre Spillway	St. Charles	*	
Lake Bruin	Tensas	*	*
Chicot Lake	Evangeline	*	*
Clear Lake	Bossier	*	
Davis Lake	Caldwell		
Harmon Lake	Bossier		*
Horseshoe Lake	Avoyelles	*	
Horseshoe Lake	Morehouse	*	
Iatt Lake	Grant	*	
Bayou Lacassine	Jefferson Davis		*
Lake Martin	St. Martin	*	
Lake Providence	East Carroll	*	*
Rockefeller Refuge	Cameron	*	
Lake St. John	Concordia	*	

STATE FISH HATCHERY PROGRAM

MAX SUMMERS

Project Leader

SAMMY STOKES

Assistant Project Leader

At the present time the Commission's three fish hatcheries are producing, rearing, and stocking fish at a rate necessary to keep pace with available areas which are suitable for fish propagation and management.

During the preceding biennium our state hatcheries produced and stocked 940,760 large mouth bass (*Micropterus salmoides*), 3,188,041 bluegill sunfish (*Lepomis macrochirus*), 134,050 black crappie (*Po-*



Talapia, an imported fish that is being raised at Lacombe Fish Hatchery. This is a tropical fish that is killed by low water temperatures.

moxis nigromaculatus), and 25,750 channel catfish (*Ictalurus punctatus*). These fish were planted in 114 ponds, lakes, and other water bodies throughout Louisiana.

The type of areas receiving fish from this Commission were private ponds, semi-private lakes, and public bodies of water suited to fish growth and reproduction. Among the public waters receiving fish were: Audubon Park Lagoon in New Orleans; Anacoco Lake near Leesville; Black Lake near

Campti; Cocodrie Lake near Forest Hill; Bundicks Creek near DeRidder; Bussy Lake near Bastrop; Flagg Lake, Barksdale Air Force Base in Bossier City; Giruard Park Lake in Lafayette; Kepler Creek Lake near Gibsland; Palm Lake in Slidell; Roundaway Bayou in Tallulah; Sam Houston State Park Lake near Lake Charles; Sayres Lake in Mangham; and Sniders Lake in Slidell. These areas were stocked with the number and species of fish determined suitable by fisheries biologists of the Louisiana Wild Life and Fisheries Commission.

Because of management and operational necessity our hatcheries are now operating at sub-normal performance and production. This condition is due to



Jim Davis, Fisheries Biologist, and Louis Barnes, Fish Hatchery Manager, inspecting brood catfish at Monroe Fish Hatchery . . .

remodeling and renovation activities being conducted at two of the hatcheries.

The Beechwood Hatchery located near Forest Hill has been operating at partial production even though the majority of the ponds have been dry during installation of more efficient fish harvesting facilities. Future production will also be limited until the remainder of the remodeling has been completed.

Similarly, the James A. Noe Hatchery near Monroe has been operating at below normal production for the past two years due to improvements being made in pond design and water control facilities. Upon the completion of this work the Monroe hatchery station will again be restored to maximum production.

A reoccurring aquatic weed problem limits the production at the Huey P. Long Hatchery near Lacombe. Here noxious aquatic vegetation is hampering fish production and is largely responsible for its poor output over the past two years. The water at Lacombe is supplied by artesian wells and its quality and composition is favorable to the growth and encouragement of undesirable aquatic plants. The water temperature along with the long growing period lends to the lush growth and encroachment of the nuisance aquatics. The presence of these plants in their abundance make fish harvesting operations very difficult and nearly impossible in some cases. Much work on the control and eradication of these undesirable intruders has been accomplished and sizeable gains have been made; however, much work still remains and it will be

sometime before we can again expect freedom from these aquatics and an increase in our production capacity.

A look at individual hatchery production records for the past two years reveals Beechwood Hatchery produced 767,360 bass fingerlings and 2,119,360 fingerling blue gill sunfish. The Monroe Hatchery contributed 74,500 bass fingerlings, 715,185 blue gill fingerlings, 135,000 black crappie, and 25,750 channel catfish fingerlings. Also during this period the Lacombe Hatchery yielded 98,900 fingerling bass and 353,450 blue gill sunfish fingerlings.

For the first time in Louisiana, channel catfish were successfully spawned, reared, and stocked in



Fisheries crew seining brood catfish from Monroe Hatchery pond . . .

Louisiana waters by the Wild Life and Fisheries Commission.

Channel catfish will not usually reproduce under artificial conditions. However, by special management and fish culture methods we are able to propagate them in the fish hatcheries.

Special breeding pens and spawning containers are necessary. Brood stock are carefully selected and cared for. Individual fish are selected and carefully paired so as to insure natural spawning. These brood fish are attended daily until they spawn and the young fish hatch. After hatching the young channels are cared for and fed in the spawning con-



Brood catfish in bag of seine preparatory to pairing them off for spawning . . .

tainer or metal tub until they can be transferred into rearing ponds especially prepared for them. They are reared in these ponds until they are ready for stocking; this usually occurs in late fall.

The initial planting of channel catfish in Louisi-

ana waters is a step forward in the advancement of fisheries management and will surely open other areas of fish culture development and progress within our state conservation agency.

By reviewing our production and stocking data, we find we have been able to supply in abundance the fish necessary for the stocking of suitable water areas within Louisiana. We hope to be able to continue this facility in the future, and as the need for fishery resources becomes greater, the hatcheries will be ready to meet demands for fish of stockable quality.

When considering the overall function of the fish hatcheries, one should be aware that other areas are afforded benefit from hatchery operations and production. Fish for stocking purposes are the main objective, to be sure, but fish are also kept and grown for other reasons. Fish stocks are held for educational displays, exhibits, and sport shows. Fish are reared and distributed within our own agency for experimental purposes. Hatchery ponds are individual areas where basic fish culture and fisheries management may be studied and practiced. Also these ponds are used from time to time to carry out other needed fisheries research. The esthetic value of a hatchery should also be included when considering total worth. The science of nature and the pattern of life can be shown and better understood by observing the activities and operation of a fish culture station. Here, the hatchery can play a large role in presenting to the visiting public a better knowledge of wildlife and fisheries as a science and the necessity of increasing and protecting our wildlife resources.

The expanding population's need for recreational outlets coupled with a prospective shorter work week will tend to fully utilize most of the natural fishing areas within Louisiana.

The need for new and additional fishing areas will be apparent in the not too distant future. These areas must either be newly created sites or old areas renovated and reclaimed by fisheries management operations. In any event, the new stocks of fish to fill these areas must be produced and supplied by fish hatcheries within the state.

The present program will be increased so as to meet and fulfill all future needs for fish of stockable quality. Here in Louisiana, you can expect our hatcheries to be capable of producing and stocking the fish necessary to satisfy these increasing demands.

THE FARM POND PROGRAM

MAX SUMMERS

Project Leader

SAMMY STOKES

Assistant Project Leader

The farm pond project was set up and initiated by the Louisiana Wild Life and Fisheries Commission in 1955. Its primary purpose is to create new and easily accessible fishing areas throughout the state to meet the ever increasing fishing pressure. It is also designed to assist interested farm pond owners in obtaining basic knowledge of the fundamentals

and principles of farm pond management and fish production.

Since the beginning of this program some 441 areas have been checked and (or) stocked by the commission. These areas range in size from less than $\frac{1}{2}$ acre to well in the excess of 100 acres. For the most part these are highly desirable fishing areas for the average fisherman. Since most of these areas are within easy reach, due to their statewide distribution, it requires only a few minutes drive to one or several of these areas from any location within the state. There is also the element of expense to be considered. Most of these areas need no special equipment such as boats, motors, etc., to be fished thoroughly. Due to their size, almost any part of the pond can be reached by the use of a casting or fly rod from the water's edge. It might be added that the ponds which have been stocked with the proper kinds and number of fish and have been properly managed produce very high yields of game fish; frequently in excess of two hundred pounds per acre per year.

A farm pond owner wishing to have his pond checked or stocked with fish must submit an application to the Louisiana Wild Life and Fisheries Commission, 400 Royal St., New Orleans, La. The application can be obtained from the above address.

After the application has been received, a personal visit is made to the pond owner by a fisheries biologist to discuss and assist him in correcting his problems by mapping out a management program.

Usually a fish population sample of the pond is taken before making recommendations as to how to correct his problems. The sample is taken by the use of a hand seine or a chemical called rotenone. If the pond is newly constructed and void of fish life or has been reclaimed by the use of rotenone, it is stocked with fingerling bluegill (*Lepomis macrochirus*) and largemouth bass (*Micropterus salmoides*) from one of the three hatcheries within the state. The stocking service is done without any charge to the pond owner.

With the advancement in farm fish pond management techniques and a mushrooming public interest, we are going to see a great deal more of this "farm pond fishing" with an even greater success in the not too distant future.

IMPOUNDMENT TIMBER EVALUATION PROJECT

LLOYD POSEY

Project Leader

A research project has been initiated which is designed to compare the effect of complete timber removal with the practice of allowing the timber to remain standing in man-made impoundments. Two similar impoundments, one timbered and the other completely cleared, are planned for construction. When the impoundments are completed, they will be stocked with an equal number of fish. In order to derive an accurate determination of total production, fishing will be prohibited. Reproduction studies will

be conducted annually and quarterly bottom and plankton samples will be taken. At the end of a specified period, both impoundments will be drained. Each fish will be weighed, measured, and recorded. The production of the two impoundments will be compared and carefully analyzed.

Bodcau Game Management area was chosen as the location for this project since it is owned by the U.S. Army Corps of Engineers and is leased to the Louisiana Wild Life and Fisheries Commission. Preliminary planning and an investigation for suitable impoundment locations has been conducted. It is our hope that this experiment will give us valuable information that may be used in planning future impoundments for maximum fish production and utilization.

STRIPED BASS STUDY

THOMAS D. ALLEN, JR.

Project Leader

Because of the great potential in sport and commercial fishing in the Bogue Falaya and Tchefuncta Rivers, a study has been inaugurated to obtain information regarding the striped bass, *Roccus saxatilis*, and other important species of fish.

This study was begun in 1957 and had to be discontinued for a time due to the shortage of fishery personnel.

The project will be devoted mainly to the chemical and physical factors affecting fish production in the area. Hoop nets will be fished in the area during March and April; the time striped bass occur.

Six sampling stations, from the mouth of the river to its headwaters, have been selected for the project. At each station a test will be conducted for dissolved oxygen, free carbon dioxide, pH, and alkalinity. The temperature of both air and water will be taken along with a secchi disc reading. Water samples will be taken and returned to the laboratory where checks for color, turbidity, and salinity will be conducted.

The above data will help in determining the environmental factors necessary for the reproduction of striped bass and whether or not they come into the river for purposes of spawning as well as feeding.

DINGELL-JOHNSON PROJECT F-1-R FISH POPULATION INVESTIGATION

VICTOR W. LAMBOU

Project Leader

On April 1, 1953, Dingell-Johnson Project F-1-R (Fish Population Investigations) was initiated in order to gather basic information needed to plan a constructive sport fish management program. The Fifth, Sixth, and Seventh Biennial Reports covered the progress of the project through December 31, 1957.

During the biennium, considerable progress was made in realizing the project's objectives. Much of the project's findings have been reported in the form of progress reports. The following project reports were prepared during the biennium:

1. The Lake Bistineau Controversy.



Victor Lambou, Fisheries Biologist, writing progress report.

2. Clear Lake Creel Census, September, 1953 through August, 1954.
3. Clear Lake Creel Census, September, 1954 through August, 1955.
4. Clear Lake Creel Census, September, 1955 through August, 1956.
5. Clear Lake Creel Census, September, 1956 through August, 1957.
6. Clear Lake Creel Census—Materials and Methods, September, 1953 through August, 1957.
7. Successful Bass, Crappie, and Sunfish Fishing Parties and Parties Making Limit Catches on Clear Lake and Lake Bistineau.
8. Lake Bistineau Creel Census, May, 1955 through August, 1956, Sport Fish Catch by Months.
9. Lake Bistineau Creel Census, May, 1955 through August, 1956, Sport Fish Catch by Areas and Months.
10. Removal of Rough Fishes from Clear Lake.
11. Abundance of Small Fishes in Lake Bistineau and Bayou Dorcheat.
12. Clear Lake Creel Census, September, 1957 through August, 1958.
13. Clear Lake Creel Census—Materials and Methods, September, 1957 through August, 1958.
14. Block-Off Net for Taking Quantitative Fish Population Samples.
15. Successful Bass, Crappie, and Sunfish Fishing Parties and Parties Making Limit Catches on Clear Lake—September, 1957 through August, 1958.
16. Preliminary Report, Efficiency and Selectivity of Flag Gill Nets Fished in Lake Bistineau.
17. Average Weights of Some Fishes Caught by Sport Fishing on Clear Lake, September, 1953 through August, 1958.
18. Selected Bibliography, Fish and Related Subjects.
19. Lake Bistineau Creel Census—Materials and Methods, May, 1955 through August, 1956.
20. Preliminary Report on Fish Populations Occurring in Alluvial Flood Plain Lakes.
21. Preliminary Report, Louisiana Impoundments—Their Characteristics.

22. Preliminary Report on Fish Population Samples Taken From Clear Lake.
23. Length Frequency Distributions of Fishes Occurring in Clear Lake.
24. Clear Lake Creel Census, Materials and Methods, September, 1958 through August, 1959.
25. Preliminary Report on the Fish Population Occurring in the Comite River.
26. Preliminary Report on Fish Population Samples Taken from Lake Verret.
27. Simplified Creel Census Program for Punch Card Tabulation.
28. A Contribution Toward A Bibliography On Use of Machine Methods In Processing Fishery Data.
29. Comparison of Catch of Sport Fish by Fishing Parties of Different Races on Clear Lake, Richland Parish, Louisiana.
30. Comparison of Catch of Sport Fish by Fishing Parties of Different Races on Clear Lake, Richland Parish, Louisiana—Supplement No. 1.

The data contained in the above mentioned reports are much too complex and numerous to be given in their entirety in a report of this nature. Therefore, only a brief summary of some of the more important findings will be presented. The reader who desires more detailed information is referred to the progress reports.

Various technical papers were presented at technical fishery meetings and/or published in technical journals. These papers are as follows:

1. Growth Rate of Young-Of-The-Year Large-mouth Bass, Black Crappie, and White Crappie In Some Louisiana Lakes. The Proc. of the Louisiana Academy of Sciences, Vol. 21, (1958).
2. Fish Populations Occurring In The Backwater Lakes of Louisiana. Presented at the Eighty-eighth Annual Meeting of the American Fisheries Society, September 1958, Philadelphia, Pennsylvania.
3. Creel Census Methods Used on Clear Lake, Richland Parish, Louisiana. Proc. of the Twelfth Annual Conference S. E. Association of Game and Fish Commissioners (1959).
4. Preliminary Report On The Effects of the Removal of Rough Fishes on The Clear Lake Sport Fishery. Proc. of the Twelfth Annual Conference S. E. Association of Game and Fish Commissioners (1959).
5. Fish Populations of Backwater Lakes in Louisiana. Tran. of the American Fisheries Society, Vol. 88, No. 1 (1959).
6. Block-Off Net for Taking Fish Population Samples. The Progressive Fish Culturist, Vol. 21, No. 3 (1959).
7. Louisiana Impoundments—Their Fish Populations and Management. Tran. of the 24th North American Wildlife Conference, (1959).
8. Fish Populations of the Streams on the Red Dirt Game Management Area, Natchitoches Parish, Louisiana. The Proc. of the Louisiana Academy of Sciences, Vol. 22 (In press).
9. Use of Machine Methods in Processing Fishery Data. Presented at the Thirteenth Annual

Conference of the Southeastern Association of Game and Fish Commissioners, October, 1959, Baltimore, Maryland.

EFFECTS OF THE REMOVAL OF ROUGH FISHES ON THE CLEAR LAKE SPORT FISHERY

Clear Lake, an oxbow lake of approximately 115 acres, is located in northeast Louisiana. Most water in the lake has a depth of 5 to 10 feet. Clear Lake was selected as a study area on which to evaluate experimental fish management practices. Fish population samples taken by rotenoning during 1953 showed that the standing crop of fish consisted of approximately 90 per cent, by weight, of gizzard shad. Following the removal of rough fishes by seining, intensive investigations were conducted to determine the effects on the fish population and the sport fishing. This section will concern itself primarily with the changes occurring in the sport fishing over a five year period, September, 1953 through August, 1958.

Removal of Rough Fishes

The principal rough fish removal operations were carried out during the winter and spring of 1953-54. Rough fishes removed after that period were only incidental to other operations. Table 1 summarizes the results of the rough fish removal operations.

Fish were removed during the winters and springs of 1953-54 and 1954-55 with a 400 yard haul seine which had a 1 inch square mesh pocket. During October of 1955, the lake was seined with a 300 yard seine of 2 inch square mesh webbing. An 800 yard haul seine with a 1 inch square mesh pocket was used during February and March, 1956.

Creel Census

In order to determine changes occurring in the sport fishery, an intensive creel census was conducted from September, 1953 through August, 1958.

Some night fishing, primarily for bass, occurred during the summer months; however, it is believed that this fishing comprised but a very small per cent of the total fishing pressure. This night fishing was not sampled and, therefore, estimates of the total harvest of bass from the lake should be considered a minimum.

Relative Importance of the Various Kinds of Fishing

Practically all of the sport fishing on Clear Lake was for bass, crappie and sunfish. Sport fishing for striped bass (yellow bass) occurred only during the second and third census years—it amounted to less than one per cent of the total man-hours. Some striped bass were caught during other years by fishermen fishing for other kinds of fish.

There was relatively little fishing for bass during the first census year (3.7 per cent of the total man-hours); however, the importance of bass fishing increased each succeeding year and during the fifth year it comprised 30.2 per cent of the total man-hours of fishing.

The per cent crappie fishing comprised of the

total man-hours of fishing ranged from 16.6 during the third year to 31.3 during the fourth year. Crappie fishing made up 27.6 per cent of the total man-hours of fishing during both the first and fifth years.

During the first and second years sunfish fishing comprised 68.7 and 76.6 per cent of the total man-hours of fishing respectively. Each succeeding year the importance of sunfish fishing declined and during the fifth year it comprised only 42.2 per cent of the total man-hours of fishing.

Composition of the Catch

There were extensive changes in the relative composition of the sport fish catch. The importance of bass from both a numerical and weight standpoint increased considerably during the five census years. Bass comprised 1.0 per cent of the total number and 4.3 per cent of the total pounds of fish caught during the first year, while they comprised 12.8 per cent of the total number and 47.0 per cent of the total pounds during the fifth year.

The importance of crappie from a numerical standpoint ranged from 4.9 per cent of the total number of fish caught during the fourth year to 11.3 per cent during the first year. The per cent crappie comprised of the total pounds of fish caught ranged from 13.5 during the third year to 29.2 during the first year.

The per cent sunfish made up of the total number of fish caught ranged from 72.0 during the fifth year to 88.0 during the third year. Sunfish comprised from 60.3 to 67.8 per cent of the total pounds of fish caught during the first three years. There was considerable decrease in the importance of sunfish during the last two years when they comprised 39.3 and 27.4 per cent of the total pounds of fish caught respectively.

Striped bass made up from 1.3 per cent of the total number of fish caught during the first year to 7.4 per cent during the fifth year. The per cent striped bass comprised of the total pounds of fish caught ranged from 1.5 during the first year to 7.5 during the fifth year.

The principal species of fish occurring in the catch, from both a numerical and weight standpoint, were the largemouth bass, white crappie, bluegill sunfish, redear sunfish, warmouth sunfish, longear sunfish and yellow bass.

Total Fishing

The total number of fish caught per man-hour of effort, the total man-hours of fishing, and the total harvest increased considerably during the second year of the census and then decreased during the succeeding years. During the last year the total man-hours of fishing and the total pounds of fish harvested were less than during the first year. The average weights of all fish caught ranged between 0.2 and 0.4 of a pound.

Factors Affecting Changes in the Sport Fishery

Certainly all changes occurring in the sport fish-

ery cannot be attributed to the removal of rough fishes. Sport fisheries and the fish populations on which they are dependent are not static, and they change even where no attempts at management have been made. There are many variables which affect sport fisheries and fish populations, e.g., the weather, composition of the fishermen population, land use, economic conditions in the surrounding areas, changes occurring in the sport fisheries on near-by waters and many others. Some of these variables we could not measure and others were unknown. However, many of the observed changes occurring in the sport fishery were of such magnitude that it is believed they were influenced to some extent by the removal of rough fishes.

Immediate Effects of the Removal of Rough Fishes

On the whole, the immediate effects of the removal of rough fishes on the sport fishery were very desirable. The number of fish caught per man-hour of effort, the fishing pressure and the total pounds of fish caught increased considerably during the second census year for all types of fishing; however, the pounds of sunfish caught per man-hour of effort decreased somewhat during the second year.

The Removal of Rough Fishes as a Management Tool

Rough fish removal, especially the removal of gizzard shad by selective poisoning, has become very much in style in the Southeast. Many sportsmen are selling it as a cure-all. We definitely are of the opinion that it is not a cure-all in fishery management, and in some instances it may be detrimental—for instance: if the removal of gizzard shad induces an overcrowded sunfish population in a large lake, how are we going to correct this problem?

Undoubtedly, under many conditions, the removal of rough fishes is a useful management tool; however, our knowledge of how and when to use this tool is fragmentary. Much more information than currently available is needed in order to predict with any degree of accuracy the outcome of rough fish removal operations under varying conditions.

There are many factors which could influence the results obtained from rough fish removal—for example: (1) the physical characteristics of the lake—size, depth, etc., (2) the make-up of the fish population at the initiation of rough fish removal operations and (3) how the rough fish are removed—for example: selective poisoning vs. seining; removal over a period of years vs. removal during one year. Clear Lake differs from many lakes in the Southeast; and therefore, the results obtained do not necessarily hold true for southeastern lakes in general. Many lakes on which rough fish removal is being carried out are larger than Clear Lake. Most of the removals of gizzard shad are now being accomplished through selective poisoning which removes all size classes of fish. Gizzard shad were removed from Clear Lake by seining, which is selective for the larger size fish.

LOUISIANA IMPOUNDMENTS THEIR FISH POPULATIONS AND MANAGEMENT

For the purpose of this section, only impoundments which have their watersheds in the upland timber type areas of Louisiana and are at least 500 acres in size are considered. All these impoundments have some type of man-made water control structure. Excluded are all bodies of water located in the alluvial flood plain areas, prairie regions, and the coastal marshes of the state.

There are 18 impoundments in Louisiana. Three of the impoundments (D'Arbonne, Upper Anacoco, Bundick) are in various stages of construction or have been authorized by the Louisiana Legislature. The topography of the areas in which they are located varies from undulating and gently rolling to fairly hilly. The major forest types of these areas are the southern pines (longleaf, *Pinus palustris*, slash, *Pinus elliottii*; loblolly, *Pinus taeda*, and shortleaf, *Pinus echinata*) and upland hardwoods (post oak, *Quercus stellata*; blackjack oak, *Quercus marilandica*; southern red oak, *Quercus falcata*; white hickory, *Carya tomentosa*; sand hickory, *Carya pallida*; etc.). Much of the forests have been cut over and are in various stages of reforestation.

Bottomland hardwoods (water oak, *Quercus nigra*; willow oak, *Quercus phellos*; overcup oak, *Quercus lyrata*; black willow, *Salix nigra*; tupelo gum, *Nyssa aquatica*; etc.), and baldcypress (*Taxodium distichum*) occur in the stream bottoms. It is mostly these bottoms which were dammed in constructing the impoundments.

Row crop agriculture is not common in these areas. Grazing and timber production are the primary land uses. The soils of these areas are relatively low in fertility and are generally acid in nature.

Impoundments, from which water quality data are available, were found to be slightly acid. Total alkalinity was usually less than 25 ppm. Normally the impoundments are very clear—except during periods of excessive rainfall. It would appear that in most of the impoundments, due to their shallowness, wind action usually will not allow a permanent stratification during the summer.

Because of the relative shallowness and clearness of the impoundments, submergent aquatics and various filamentous algae are extremely abundant; in fact, so abundant they often seriously interfere with sport fishing. Water hyacinths (*Eichornia crassipes*) are present in most of the impoundments but for the most part are not abundant enough to seriously interfere with fishing.

In most of the impoundments, water levels are relatively stable. The two exceptions to this are Chicot Lake, which is fluctuated primarily to control submergent aquatic weeds, and Cross Lake, which fluctuates according to the water needs of the city of Shreveport.

The majority of the impoundments were built for recreational purposes, i.e., fishing, hunting, and boating. Only 4 of the 18 impoundments were constructed primarily for water supply, flood control and/or navigation; however, all the impoundments

are used extensively for recreational purposes. In the aggregate the impoundments support a considerable amount of sport fishing; however, no data are available as to exact size of this fishery.

Most of the impoundments support some commercial fishing; however, this fishery is not very large, especially when compared with the commercial fisheries on other types of waters in the state. Most of the impoundments are used to a greater or lesser extent for waterfowl hunting.

The majority of the impoundments are not managed by the Louisiana Wild Life and Fisheries Commission even though recreation (mainly fishing) was the primary purpose of building the impoundments. Local game and fish commissions have primary jurisdiction over seven of the impoundments, federal government agencies over three, parish governments over two, watershed and water conservation districts over two, Louisiana State Parks and Recreation Commission over one and a municipal government over one. The Louisiana Wild Life and Fisheries Commission has primary jurisdiction over two impoundments. Because these local game and fish commissions are peculiar to Louisiana, the nature of these agencies needs further clarification. The Lake Bistineau Game and Fish Commission, set up by an act of the Louisiana Legislature, is typical of these agencies. The commission is composed of three members, one elected by each of the three police juries of the three parishes bordering Lake Bistineau. The commission has the power and authority to regulate and control the taking of game or fish; to establish closed seasons; to fix game and fish limits; to employ wardens, to fix fees for hunting and fishing on the lake; to buy, lease or sell property; to lease or let the privilege of commercial fishing; establish fish hatcheries; etc. However, all rules and regulations made by the Lake Bistineau Game and Fish Commission are subject to approval by the Louisiana Wild Life and Fisheries Commission. This control of the impoundments by many different agencies is not conducive to a consistent, sound, statewide fishery research and management program.

Since the impoundments were rather shallow (mostly less than 20 feet deep), it was possible to sample nearly all areas of the impoundments. The sampling areas were surrounded by a 1 inch square-mesh net. Fish were recovered over a 2 day period and every possible effort was made to pick up all fish, including small.

Recovery from each sampling area was converted to pounds of fish per acre so that each sample obtained from an impoundment would be given equal weight.

All species of fish that sportsmen normally fish for were grouped under the heading of game fish. Available game fish (harvestable-size game fish) are those considered to be of a size large enough to be creeled by sport fishermen. Since there is no size limit on game fish in Louisiana, any minimum size assigned to a species of fish is arbitrary.

All species of fish that are regularly or occasionally sold commercially were grouped under the heading of commercial fish. Available commercial fish are those of a size that can be sold legally.

Standing Crops of Fish

Standing crops of fish (pounds of fish per acre) occurring in the impoundments were low—on the average much lower than the standing crops of fish occurring in other types of habitat in Louisiana. An average of 73 pounds of fish per acre was recovered from the impoundments. On the average, 397 pounds of fish per acre by rotenone poisoning from backwater lakes and 202 pounds of fish per acre by rotenone poisoning from Mississippi River oxbow lakes in Louisiana.

These differences can be partly explained by the basic fertility of the soil types in which the various types of water are located. The impoundments are located in relatively infertile soil areas of Louisiana while the other types of lakes are located in the alluvial flood plain areas of Louisiana which are rich in the basic elements essential to the subsistence of plant and animal life.

An average of 59 pounds of non-predaceous fish per acre was recovered from the impoundments comprising 81 per cent of the standing crops.

An average of 14 pounds of predaceous fish per acre was recovered from the impoundments comprising 20 per cent of the standing crops. Largemouth bass and black crappie were the principal predaceous fishes occurring in the impoundments comprising, on the average, 10 and 3 per cent of the standing crops respectively.

An average of 35 pounds of game fish per acre was recovered from the impoundments. Game fish comprised an average of 52 per cent of the standing crops.

An average of 8 pounds of commercial fish per acre was recovered from the impoundments. Commercial fish comprised an average of 14 per cent of the standing crops. Approximately 56 per cent of the total poundage of game fish consisted of available-size fish.

Management of Impoundments for Sport Fishing

In the past, management procedures for the impoundments have consisted of the following: regulation of the sport fishing, regulation of the commercial fishing, stocking, building of fish ladders, spraying of water hyacinths with 2, 4-D (2, 4-dichlorophenoxyacetic acid) and fluctuation of water levels. As would be expected, due to the many different agencies having jurisdiction over the impoundments, management procedures have varied considerably from impoundment to impoundment.

At the present there are no special regulations on the impoundments pertaining to sport fishing—this has not always been the case. Louisiana has no size limits or closed seasons on game fish. State-wide daily creel limits are as follows: 50 sunfish, 25 crappie, 25 striped bass (white bass, *Roctus chrysops*, and/or yellow bass) and 15 black bass per day. It is doubtful if further liberalization of creel limits on the impoundments would have any appreciable effect on the sport fish harvest. For example, from the period May, 1955 through August, 1956, not 1 out of 923 bass fishing parties checked on Lake Bistineau and who had completed their

fishing trip made a limit catch. During the same period, only 3 fishing parties out of 447 fishing for crappie and only 10 fishing parties out of 1,058 fishing for sunfish made limit catches.

In the past there have been many instances of closing impoundments to commercial fishing. At the present, commercial fishing is not allowed on three impoundments. No reason is known why commercial fishing should not be allowed on all the impoundments. Commercial fish are not very abundant in the impoundments and it is doubtful that either restricting or allowing commercial fishing will have much effect on the fish population. Nevertheless, commercial fishing should be allowed since it utilizes a resource that would otherwise be wasted.

On Lakes Chicot and Bistineau fish ladders were constructed in order to pass fish which congregate below the dams into the impoundments. A study of the Chicot Lake fishway has shown rather conclusively that no benefits occur from having such a structure.

One of the most successful attempts at management has been the water hyacinth control program of the Louisiana Wild Life and Fisheries Commission. Whenever water hyacinths become overabundant on any of the impoundments, they are sprayed with 2, 4-D. Were it not for this program, the impoundments would become almost completely covered with water hyacinths which would eliminate their value for recreational purposes.

The water level of Chicot Lake has been fluctuated in order to control submergent aquatics. Chicot Lake is usually drawn down during early winter and refilled early the following spring and these drawdowns have materially reduced the abundance of aquatics in the lake. Management plans calling for a late summer or fall drawdown have been proposed for other impoundments, however, these plans have not been put into effect.

It appears that controlled drawdowns of water levels during late summer or fall offer the best possibility as a sport fishery management tool for the impoundments. It is believed that drawdowns will increase the fertility of the impoundments and improve the structure of the fish population as well as help to control overabundant aquatics. Drawdowns have also been recommended for the impoundments by game biologists in order to improve their attractiveness to waterfowl. It is recognized that considerably more research needs to be done on the use of drawdowns in the management of these impoundments. However, it is believed that on the basis of what is presently known, drawdowns should be recommended for the impoundments.

FISH POPULATIONS OF BACKWATER LAKES IN LOUISIANA

The major backwaters of Louisiana are located in the flood plain areas of the Mississippi, Red, Black and Atchafalaya Rivers. Less extensive backwaters are found along smaller streams such as the Ouachita and Pearl Rivers. The flood plains are dissected by an intricate system of large numbers of shallow lakes of various shapes and sizes. During periods of high water, the lakes receive backwater

directly or indirectly from nearby streams. The flood plains are quite level and consequently during periods of high water, large expanses of land which are normally dry are flooded. The majority of the backwater areas are not permanent water bodies; however, most of these areas are subject to frequent flooding from a depth of a few inches, to as much as 30 feet or more. Most high water stages occur during late winter, spring and early summer; however, the depth and extent of flooding varies from year to year and from lake to lake.

The majority of the permanent water bodies are rather shallow during the low water periods and most lakes have average depths of less than 15 feet. Most of the lakes are not very large—the majority of them are less than 5 thousand acres in area.

Aquatics—coontail (*Ceratophyllum spp.*), najas (*Najas spp.*), pondweed (*Potamogeton spp.*), etc.—are abundant in some of the lakes, however, in others they are absent. Depth and other physical characteristics of the lakes seem to influence the abundance of aquatics. Also, the depth and extent of the high water stages during spring seem to exert considerable influence on their abundance. During years when flooding is less extensive and severe, aquatics are much more abundant.

Dead trees, logs and stumps which were killed by flooding are numerous in most of the lakes. Also, scattered stands of live trees and shrubs which tolerate permanent flooding, such as baldcypress (*Taxodium distichum*), tupelo gum (*Nyssa aquatica*) and button bush (*Cephalanthus occidentalis*), are common.

The land not permanently flooded supports a luxuriant growth of herbaceous and woody plants. Much of the higher land supports extensive stands of hardwood timber while land which doesn't dry out until late in the summer supports thick growths of herbaceous plants interspersed with stands of trees which tolerate considerable flooding, such as baldcypress, black willow (*Salix nigre*) and water elm (*Planera aquatica*).

Fish populations in seven backwater lakes were sampled by rotenone poisoning. Practically all of the 17 sampling areas were 1 acre in size. Since the lakes were rather shallow (mostly less than 20 feet in depth), it was possible to sample nearly all areas in the lakes. All sampling was done during periods of low water. The sampling areas were surrounded by a 1 inch square-mesh net. Three pints of five percent emulsifiable rotenone per acre foot of water was applied by pumping the solution through a perforated hose. Fish were recovered over a 2 day period and every possible effort was made to pick up all fish, including the small.

Data obtained from rotenone poisoning or, for that matter, data obtained from samples taken with any type of gear, are more or less selective. Rotenone sampling is probably less selective than other methods. The main inaccuracy associated with this method is that varying percentages of fish occurring in the sampling area are recovered. However, all samples were taken in a similar manner and it is believed that the ratio of non-recovered fish to recovered fish was of approximately the same magni-

tude for each sampling area. If this assumption is correct, the rotenone sampling data should furnish an unbiased index to the species composition and the abundance of fish in the backwater lakes.

Some species of fish—buffalo fishes, white bass, catfishes—are highly migratory in the backwater habitats. These fishes are often very abundant in the lakes during periods of high water and while the flood waters are receding. Evidently during periods of low water many of them move back into the river channels. Very little is known relative to the movement of these fishes in Louisiana backwater habitats. Fish sampling was confined to periods of low water; and therefore, the results are not indicative of the abundance of the migratory fishes.

Standing Crops of Fish

Standing crops of fish (pounds of fish per acre) occurring in the backwater lakes were high—on the average, much higher than standing crops of fish occurring in other types of habitat in Louisiana. An average of 397 pounds of fish per acre was recovered from the lakes and the standing crops ranged from 142 for Colvett Bay to 651 for Spring Bayou Backwater Area.

An average of 230 pounds of non-predaceous fish per acre was recovered from the lakes comprising 56 percent of the standing crops. Gizzard shad, bluegill sunfish, fresh-water drum, buffalo fishes and warmouth sunfish were the principal non-predaceous fishes occurring in the lakes.

An average of 167 pounds of predaceous fish per acre was recovered from the lakes comprising 44 percent of the standing crops. Spotted gar, largemouth bass, channel catfish, bowfin and black crappie were the principal predaceous fishes occurring in the lakes. Standing crops of game fish were high with an average of 103 pounds per acre. Game fish comprised an average of 26 percent of the standing crops. An average of 169 pounds of commercial fish per acre was recovered from the lakes. Commercial fish comprised an average of 47 percent of the standing crop.

Approximately 76 percent of the total poundage of game fish consisted of available size fish. A larger percent of the standing crops of game fish consisted of available size fish in the backwater lakes than in other types of habitat in Louisiana.

Effects of Overflow on the Fish Populations

The flooding of large expanses of land during high water periods undoubtedly has much effect on the ecology of the backwater lakes.

Undoubtedly sediments deposited by the rivers have a fertilizing effect on the lakes. The sediments carried by the major rivers in Louisiana are rich in the basic elements essential to the subsistence of plant and animal life. The alluvial flood plains of the Mississippi, Red and Atchafalaya Rivers contain some of the most fertile farm lands in the Southeast. Farm lands outside of the flood plains in Louisiana are much less fertile.

The alternate exposure and flooding of land is important in maintaining and increasing the productivity of large impoundments. Undoubtedly this

same phenomenon is of importance in the backwater lakes.

The alternate exposure and flooding of land has important effects on fish populations. If the flooding occurs during the spawning season it seems to induce the reproduction of great numbers of young of some fishes—for example, largemouth bass.

The flooding should limit the intra-specific and inter-specific competition for food, space, and spawning territory. Young fish should have an extremely abundant source of food and thus their mortality rates should be reduced and growth rates increased. Food in the form of fish and swamp crayfish should be plentiful for the large predators, allowing them

to make rapid growth. The whole fish population should be rapidly expanding in numbers and weight.

Undoubtedly the above phenomenon largely determines the type of fish population present during low water periods. However, even during low water, the backwater lakes are able to support large fish populations and large numbers of game fish. This is indicated by: (1) the high poundage of fish recovered from the sampling areas during low water periods; (2) the apparent excellent condition of both predaceous and non-predaceous fish during these periods; (3) the adequate representation of all sizes of fish in the samples and (+) the high quality of the sport fishing during low water periods.

Characteristics of Louisiana Impoundments

Name of Lake	Area (acres)	Volume (acre-feet)	Drainage Area (square miles)	Average Depth (feet)	Shoreline (miles)	Date Completed	Age (years)
Black Bayou Lake	3,960	17,000	220	4.3	24.0	1943	16
Caddo Lake	32,700*	175,000	2,740	5.0	131.0	1914	45
Cross Lake	8,960	70,585	243	8.0	58.0	1925	34
Wallace Lake	2,300	7,800	260	3.4	30.0	1946	13
Smithport Lake	2,950	11,500	205	3.9	17.0	1949	10
Ivan Lake	520	3,360	55	6.5	12.3	1958	1
Lake Bistineau	17,200	120,400	1,410	7.0	53.5	1938	21
Kepler Creek Lake	1,725	14,500	46	8.4	15.0	1958	1
Corney Lake	1,900	7,800	443	4.1	13.5	1936	23
D'Arbonne	12,500	95,000	1,585	7.6	103.0	.....	.....
Cheniere Brake	3,000	16,000	140	5.3	21.2	1947	12
Black Lake	13,800	109,000	920	7.9	50.5	1933	26
Saline Lake	8,700	52,000	420	6.0	42.0	1932	27
Iatt Lake	5,350	13,500	242	2.5	35.5	1957	2
Upper Anacoco	4,250	57,000	112	13.4	30.5	.....	.....
Anacoco Lake	2,600	24,000	209	9.2	14.0	1951	8
Bundicks Lake	1,750	9,200	206	5.3	12.9	.....	.....
Chicot Lake	1,625	9,700	57	6.0	26.0	1943	16

*Caddo Lake has an area of 32,700 acres of which 19,450 acres are located in Texas.

Summary of the Characteristics of Louisiana Impoundments

	EXISTING IMPOUNDMENTS (15 impoundments)			EXISTING AND AUTHORIZED IMPOUNDMENTS (18 impoundments)		
	Total	Average	Range	Total	Average	Range
Area (acres)*	107,290	7,153	520 - 32,700	125,790	6,988	520 - 32,700
Volume (acre-feet)	652,145	43,476	3,360 -175,000	813,345	45,186	3,360 -175,000
Drainage Area (square miles) ..	7,610	507	46 - 2,740	9,513	529	46 - 2,740
Average Depth (feet) .....	.....	6.1	2.5- 9.2	.....	6.5	2.5- 13.4
Shoreline (miles)	543.5	36.2	12.3- 131.0	689.9	38.3	12.3- 131.0
Age (years)	255	17	1 - 45	.....	.....	.....

*Caddo Lake has an area of 32,700 acres of which 19,450 acres are located in Texas; therefore, the total area of impoundments in Louisiana is 106,340 acres.

Location, Purpose and Administration of Louisiana Impoundments

NAME OF LAKE	LOCATION (Parish)	PURPOSE			OPERATED BY					
		Recreation	Water Supply	Other	La. Wild Life & Fisheries Comm.	Local Game & Fish Comm.	Parish Govt.	Municipal Govt.	Federal Govt.	Other
Black Bayou Lake	Caddo	X	.....	.....	X	.....	.....	.....	.....	.....
Caddo Lake	Caddo .....	.....	.....	X ¹	.....	.....	.....	.....	X ²	.....
Cross Lake	Caddo .....	.....	X	.....	.....	.....	.....	X	.....	.....
Wallace Lake	Caddo .....	.....	.....	X ³	.....	.....	.....	.....	X ²	.....
Smithport Lake	De Soto	X	.....	.....	.....	X	.....	.....	.....	.....
Ivan Lake	Bossier	X	.....	.....	.....	.....	X	.....	.....	.....
Lake Bistineau	Bossier, Bienville, Webster	X	.....	.....	.....	X	.....	.....	.....	.....
Kepler Creek Lake	Bienville	X	.....	.....	.....	.....	X	.....	.....	.....
Corney Lake	Claiborne	X	.....	.....	.....	.....	.....	.....	X ⁴	.....
D'Arbonne	Union	X	.....	.....	.....	.....	.....	.....	.....	X ⁵
Cheniere Brake	Ouachita	X	.....	.....	X	.....	.....	.....	.....	.....
Black Lake	Natchitoches	X	.....	.....	.....	X	.....	.....	.....	.....
Saline Lake	Winn, Natchitoches	X	.....	.....	.....	X	.....	.....	.....	.....
Iatt Lake	Grant	X	.....	.....	.....	.....	.....	.....	.....	X ⁶
Upper Anacoco	Vernon .....	.....	X	.....	.....	X	.....	.....	.....	.....
Anacoco Lake	Vernon	X	.....	.....	.....	X	.....	.....	.....	.....
Bundicks Lake	Beauregard	X	.....	.....	.....	X	.....	.....	.....	.....
Chicot Lake	Evangeline	X	.....	.....	.....	.....	.....	.....	.....	X ⁷

- X¹ Navigation
X² Corps of Engineers
X³ Flood Control
X⁴ Forest Service
X⁵ Bayou D'Arbonne Lake Watershed District
X⁶ Iatt Lake Water Conservation District
X⁷ Louisiana Parks and Recreation Commission

Summary of Purpose and Administration of Louisiana Impoundments and Miscellaneous Information on the Impoundments

	Existing Impoundments (15 impoundments)		Existing and Authorized Impoundments (18 impoundments)	
	Number of Impoundments	% of Total No. of Impoundments	Number of Impoundments	% of Total No. of Impoundments
Impoundments built for recreation	12	80.0	14	77.8
Impoundments built for water supply	1	6.7	2	11.1
Impoundments built for navigation	1	6.7	1	5.6
Impoundments built for flood control	1	6.7	1	5.6
Louisiana Wild Life and Fisheries Commission				
has primary jurisdiction	2	13.3	2	11.1
Local game and fish commissions have primary jurisdiction	5	33.3	7	38.9
Parish governments have primary jurisdiction	2	13.3	2	11.1
Municipal government has primary jurisdiction	1	6.7	1	5.6
Federal government has primary jurisdiction	3	20.0	3	16.7
Watershed district has primary jurisdiction .....	.....	.....	1	5.6
Water conservation district has primary jurisdiction	1	6.7	1	5.6
State parks and recreation commission has primary jurisdiction	1	6.7	1	5.6
Submergent aquatics not abundant	4	26.7	.....	.....
Submergent aquatics abundant	11	73.3	.....	.....
Timber cleared prior to impoundment	1	6.7	1	5.6
Timber not cleared prior to impoundment	14	93.3	17	94.4
Commercial fishing not allowed or restricted	3	20.0	3	16.7
Commercial fishing allowed according to state wide regulations	12	80.0	15	83.3

Standing Crops of Fish, as Determined by Use of Rotenone, in Several Louisiana Backwater Lakes and Structure of Populations as Percentages of Predaceous, Non-Predaceous, Game and Commercial Fishes

Lake	Standing crop pounds per acre	Percent of total weight						Principal species—those making up more than 3 percent of total weight
		Non-pre-daceous	Pre-daceous	Game fish		Commercial fish		
				Total	Available	Total	Available	
Spring Bayou Backwater Area	650.9	82.9	17.1	26.1	24.0	11.0	7.6	Gizzard shad, black crappie, bluegill sunfish, buffalo fishes, largemouth bass, redear sunfish
Old River	533.8	78.6	21.4	19.8	16.8	28.4	14.5	Gizzard shad, fresh-water drum, channel catfish, largemouth bass, bluegill sunfish, redear sunfish
Bayou Courtableau Pitts	227.8	63.1	36.9	37.2	23.1	22.4	22.4	Gizzard shad, bluegill sunfish, bowfin, largemouth bass, black crappie, alligator gar, spotted gar
Bayou Courtableau	369.1	34.2	65.8	4.2	3.1	76.3	68.8	Spotted gar, gizzard shad, buffalo fishes, fresh-water drum, shortnose gar
Colwell Bay	141.8	52.5	47.5	23.0	19.3	74.7	65.4	Channel catfish, paddlefish, spotted gar, buffalo fishes, warmouth sunfish, fresh-water drum, largemouth bass, white crappie, flathead catfish, bluegill sunfish
Pearl River Backwater	333.8	52.6	47.4	40.6	27.7	50.6	47.5	Spotted gar, bluegill sunfish, largemouth bass, American eel, buffalo fishes, fresh-water drum, warmouth sunfish, flathead catfish, channel catfish, blue catfish, spotted sunfish
Dubloon Bayou	522.7	25.7	74.3	31.4	21.9	67.7	67.3	Spotted gar, bowfin, alligator gar, warmouth sunfish, bluegill sunfish, largemouth bass, black crappie
All lakes	397.1	55.7	44.3	26.0	19.4	47.3	41.9	Gizzard shad, spotted gar, bluegill sunfish, largemouth bass, fresh-water drum, channel catfish, bowfin, buffalo fishes, warmouth sunfish, black crappie



Miss Florence Roger, secretary in fishery section in the New Orleans office.

DINGELL-JOHNSON PROJECT F-4-R FISH POPULATIONS AND AQUATIC CONDITIONS IN POLLUTED WATERS

JAMES T. DAVIS
Project Leader

Pollution of streams in Louisiana is the subject of both research effort, and continued control. The unnecessary polluting of streams in the state robs the fishermen of over 300 linear miles of top-notch fishing each year. The removal of this effect of pollution is under the authority of the Louisiana Stream Control Commission. Research on the problem is conducted both by the Division of Water Pollution Control, as reported elsewhere, and the Freshwater and Sport Fisheries Section.

The Ouachita River and its major tributaries in Northeast Louisiana were the subject of a five year intensive pollutional study. This project was recently completed and the final report is available from the Louisiana Wild Life and Fisheries Com-



Fish kill on the Ouachita River caused by accidental release of Ammonia.

mission. A brief resume of the objectives and conclusions of the report follow.

Four major kinds of pollution are present in the Ouachita River, paper mill effluent, municipal sewage, oil and gas production effluent, and effluent from the production of industrial solvents. All can be toxic to fish and fish foods if released in appreciable quantities. No release has occurred during the last two years in quantities sufficient to cause a major fish die-off.

A study of the effects of different pollutants on the aquatic habitat was made and many aspects in-



Fish kill on the Ouachita River attributed to low dissolved oxygen and paper mill effluent.

vestigated. Water chemistry, fish migration, off-flavor and migration barriers were but a few of the facets touched upon. Tributary streams, which are largely unpolluted were used for comparative purposes. Details of the investigation and conclusions are found within the report. Probably the major conclusion reached was that for the past three years investigative methods were too gross to determine any appreciable effect of pollution on the Ouachita River. This does not indicate that pollutants did not adversely effect the river, but rather that their effects were not measurable using presently known methods.

DINGELL-JOHNSON PROJECT F-5-R AN ANALYSIS OF COMMERCIAL FISHING GEAR

JAMES T. DAVIS
Project Leader

LLOYD POSEY
Assistant Project Leader

Perpetual controversy as to the relative merits of commercial fishing gear prompted the Louisiana legislature to request a study be made. Accordingly this project was initiated in 1955. All types of legal gear were studied and some presently illegal



N. H. White and Russell White, seine fishermen, removing fish from trammel net on Project F-5-R.

types such as wire traps, basket traps, and electric shockers were given a thorough screening.

As a result of this study, the fisheries section recommended to the commission that all present types of legal gear, seines, trammel nets, gill nets, hoop nets, and trot lines be retained as legal gear. In addition, it was recommended that the use of basket traps be legalized.

Mesh sizes underwent a thorough screening. After the work was completed it was recommended that the following mesh sizes be declared legal throughout Louisiana:

Trammel nets—3 inch mesh or larger (bar measure)

Gill nets—3 inch mesh or larger (bar measure)

Hoop nets—2½ inch mesh or larger (bar measure)

Seines—2½ inch mesh or larger (bar measure) (does not include bait or minnow seines)

The size of hooks and baits on trot lines also was studied intensively. It was determined that hook size had little effect on the catch of sport fish. Bait used also affected the catch of sport fish to a minor degree. Therefore it was recommended that all hook sizes continue to be legal and any bait be legalized for use.

It was further recommended that wire traps, electrical fish collection devices, and the use of dynamite in fish catching be continued as illegal practices.

The complete report as to findings of this project may be secured from the Louisiana Wild Life and Fisheries Commission.



One throat wire trap as used in fish sampling on the Ouachita River.

DINGELL-JOHNSON PROJECT F-6-R

"AN ECOLOGICAL SURVEY OF FACTORS AFFECTING FISH PRODUCTION IN LOUISIANA WATERS"

DONALD W. GEAGAN

Project Leader

THOMAS D. ALLEN, JR.

Assistant Project Leader

This project is now in its final year of study. The three year study was inaugurated during the month of July, 1957. The objective of the project is to determine what conditions are normal in the ecology of freshwater lakes of Louisiana.

In order to have a sound fish management program, it is first necessary to have a basic understanding of the factors which affect the growth and reproduction of fish. This study is designed to afford the necessary knowledge for such work.

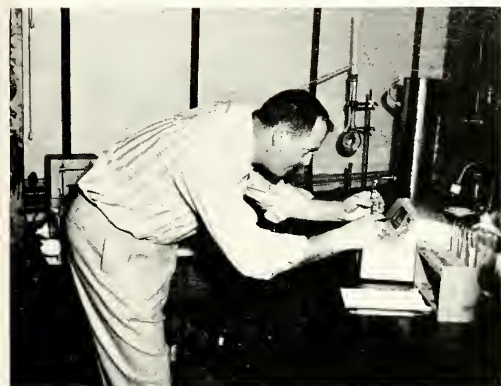
The four lakes chosen as a representative of the major freshwater habitats of Louisiana were; Caddo Lake, a large non-fluctuating impoundment; Lake Chicot, a relatively small fluctuating impoundment; Cane River Lake, an old river lake; and Lake Providence, a Mississippi River ox-bow lake. This study covers six different phases:

STUDY OF CHEMICAL AND PHYSICAL FACTORS

Physical analyses of water samples for turbidity and color, along with temperature recordings of both



Typical hoop net used in project netting. Notice method of attachment of throats.



Tommy Allen, Fishery Biologist and Ass't. Leader on Dingell-Johnson Project F-6-R, conducting a chemical analyses on lake water using a photometer.

air and water are conducted each month in the four lakes under study. Such measurements of turbidity and color may be used to indicate roughly the amounts of material suspended in water.

Water temperature is of importance in determining annual temperature cycles including the occurrence of thermal stratification. If such stratification does occur, knowledge of the location of the thermocline (the transition layer of water occurring between the upper and the lower layers of water in a stratified lake) is in itself of value in sportfishing because during prolonged stratification no fish are present below this layer.

Chemical analyses are also conducted at monthly intervals for dissolved oxygen, free carbon dioxide, alkalinity, and pH. The oxygen content of water varies from 0.0 parts per million to 25.0 ppm, depending upon the temperature, as well as chemical factors in the water. While a great decrease in free oxygen has a marked influence upon fish life, a large increase seems to have very little influence.

Carbon dioxide is an important gas in fresh water. In small quantities it is essential, rather than detrimental to aquatic plants. Yet in large quantities it is



Chemical analysis of water using the Hach Direct Reading Colorimeter.

a lethal factor, especially if the dissolved oxygen content is low.

Water samples are collected, preserved by freezing, and are returned to the New Orleans laboratory

for analyses of total and available phosphates, ammonia nitrogen, organic nitrogen, nitrate nitrogen, and nitrite nitrogen.



Mayfly nymph found in benthos sample from Caddo Lake.

Just as plant growth on land requires nitrates and phosphates in order to grow, it is equally as important to have them in the water to produce a good production of plankton for fish food. The following table gives a comparison of the field water chemistry yearly average for each lake:

Field Water Chemistry Yearly Average

(Recorded in degrees centigrade and parts per million)
Yearly Average or July 1, 1958 Through
June 30, 1959

Lake	Temperature		O ₂	CO ₂	Alkalinity			Secchi Disc. in ft.
	Sur- face	Bot- tom			ph-th	MO	pH	
Caddo	18.85	18.71	8.07	5.27	0.00	22.02	7.07	2.05
Cane Riv.	20.22	17.47	7.87	8.77	0.29	171.70	7.74	1.87
Chicot	21.40	18.22	8.25	6.13	0.17	22.60	7.00	2.61
Providence	19.90	16.28	9.68	4.21	1.37	123.28	6.76	2.97

BOTTOM FAUNA STUDIES

Bottom fauna are the microscopic organisms living on and in the bottom of the lake. This phase



Midge larva taken in benthos sample from Cane River Lake.

of the study is designed to furnish necessary information regarding the distribution and the number of invertebrates present in these lakes. These animals constitute a large part of the diet of fish.



Student laboratory worker, Lois Timken, counting fish food organisms from bottom samples.

The following table shows the organisms occurring most frequently in the samples obtained from the lakes:

Benthos Organism Distribution

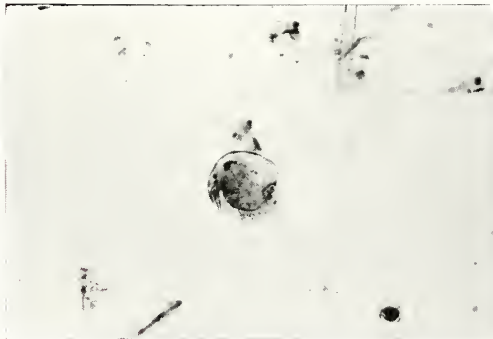
Yearly Average for Four Sampling Trips
July 1, 1958 - June 30, 1959

Organism	Caddo	Cane River	Chicot	Providence
Tendipedidae	87.5	450.6	27.6	132.6
Tubificidae	40.3	210.6	45.6	189.5
Culicidae	11.3	36.1	31.5	62.0
Ephemerae	67.6	2.4	0.6	2.1

PLANKTON STUDIES

Plankton are free floating, microscopic plants and animals in the water. The aspect of this phase of the project is the determination of the kind and the amount of plankton occurring in the study lakes.

These free floating organisms are the first in a series of food items of a lake's food chain that are taken by the fish. Plankton is of great importance



Cladocera taken in plankton sample from Lake Providence.

in the diet of a young fish. The success or failure of a fishery is influenced directly by the abundance and by the distribution of plankton. The fate of many fish immediately after hatching depends upon



Rotifer taken in plankton sample from Chicot Lake. The small size of the organism may be noted by comparing it to the grains of sand in the picture.

a plentiful supply of these microscopic plants and animals.

The samples are collected at a depth of three (3) feet with the use of a portable power pump. At each sampling site, a one-liter net filtered nanno-plankton sample and two (2) twenty-liter net-plankton samples are collected.

One of the two net-plankton samples is preserved in 70 percent alcohol for subsequent laboratory gravimetric analysis, and the other net-plankton sample is preserved in 10 percent formalin for qualitative analysis.

The following tables show the seasonal averages for the four lakes under study:

Net-Plankton Seasonal Average Caddo Lake

July 1958 - June 1959

(Recorded in average number per liter.)

Organism	Summer	Fall	Winter	Spring
Protozoa	450.0	150.0	183.3	250.0
Rotifers	116.7	100.0	216.7	300.0
Green Algae	133.3	50.0	16.7	5583.3
Blue Gr. Algae	—	—	—	50.0
Diatoms	—	—	50.0	400.0
Unid. Eggs	16.7	—	—	33.3
Copepods	—	2.3	5.7	7.0
Nauplii	—	5.0	32.7	18.7
Cladocera	—	0.3	2.7	6.3
Nematoda	16.7	—	—	—
Porifera	—	—	16.7	—
Chrysophyceae	—	—	—	66.7



Project personnel identifying benthos organisms.



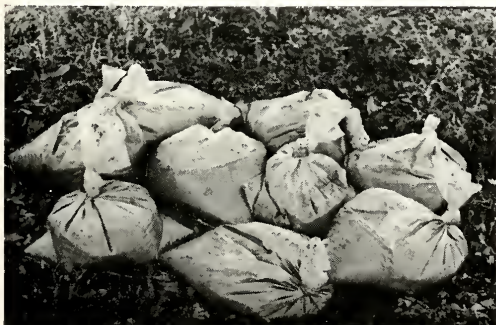
Peterson dredge with screen used in early stages of the project.

Net-Plankton Seasonal Average Cane River Lake

July 1958 - June 1959

(Recorded in average number per liter.)

Organism	Summer	Fall	Winter	Spring
Protozoa	400.0	616.7	300.0	83.3
Rotifers	300.0	250.0	666.7	1116.7
Gr. Algae	116.7	416.7	2850.0	3383.3
Blue Gr. Algae	33.3	16.7	150.0	500.0
Diatoms	66.7	183.3	4483.3	216.7
Unid. Eggs	66.7	66.7	.....	866.7
Copepods	.....	18.7	119.3	23.0
Nauplii	0.7	20.7	373.0	48.7
Cladocera	.....	98.0	442.7	47.7
Chrysophyceae	.....	.....	100.0	.....



Polyethylene bags containing bottom samples ready for transportation to the laboratory.

Net-Plankton Seasonal Average Chicot Lake

July 1958 - June 1959

(Recorded in average number per liter.)

Organism	Summer	Fall*	Winter*	Spring
Protozoa	766.7	400.0	1700.0	1170.0
Rotifers	16.7	.....	200.0	483.3

Gr. Algae	1100.0	3700.0	.....	100.0
Blue Gr. Algae	216.7	.....	.....	.....
Diatoms	216.7	300.0	1000.0	66.7
Unid. Eggs	.....	.....	.....	83.3
Copepods	4.7	1.0	5.0	6.7
Nauplii	9.5	1.0	12.0	25.3
Cladocera	0.3	.....	.....	1.7
Chrysophyceae	.....	.....	400.0	.....
Hydracarina	.....	.....	.....	.....
Tendipedidae	.....	.....	.....	0.7

*Only one sample available due to annual drawdown.



Bioassay cartons showing from left to right, standard aquarium, shipping carton, cut-away aquarium.

Net-Plankton Seasonal Average Lake Providence

July 1958 - June 1959

(Recorded in average number per liter.)

Organism	Summer	Fall	Winter	Spring
Protozoa	350.0	316.7	83.3	283.3
Rotifers	133.3	116.7	216.7	566.7
Green Algae	166.7	250.0	566.7	233.3
Blue Gr. Algae	.....	16.7	.....	.....
Diatoms	66.7	100.0	66.7	283.3
Unid. Eggs	33.3	33.3	.....	50.0
Copepods	0.5	1.0	8.3	0.3
Nauplii	1.0	2.0	11.3	8.7
Cladocera	.....	0.3	1.3	0.3



Bioassay cartons showing boxes with screen wire sides and polyethylene liners.

ABUNDANCE OF YOUNG FISH OF THE YEAR

A necessary part of a fish management program is the evaluation of the reproduction success of the fish population. The purpose of this phase of the study is to furnish such information. The spawning success of a fish depends upon many factors. A few of these factors responsible for a poor fish spawn are: overcrowding, high turbidity, temperature, high and low pH, and disease.

The following tables show the reproduction of the four lakes under study:



Top line of seine used to surround area for rotenoning.



Bottom line of lake seine showing attachment of jute twine.

Reproduction Study Caddo Lake

July 23, 1959

Average of Six (6) Samples*

Length Inches	Number of Fish					
	Longear Sunfish	Redear Sunfish	Bluegill Sunfish	Orange Spotted Sunfish	Large- mouth Bass	War- mouth
1.0	....	....	7.3	....	4.0	0.3
1.5	1.0	....	7.9	....	0.9	....
2.0	7.0	0.3	1.3	0.3	2.0	0.7
2.5	11.3	0.2	1.5	0.2	1.5	0.5
3.0	5.3	0.8	1.7	0.3	....	0.2
3.5	3.2	1.3	1.0	0.2	....	0.2
4.0	....	0.3	0.2	0.2	0.2	0.2
4.5	....	0.7	....	....	....	....
5.0	....	0.2	....	....	....	....
5.5	....	....	....	....	....	....
6.0	....	0.2	....	....	....	0.2
Total	27.8	4.0	20.9	1.2	8.6	2.3

*Each Sample—600 square feet per sample.



Minnow trap used in reproduction study on the Ouachita River.

Reproduction Study Cane River Lake

June 24, 1959

Average of Six (6) Samples*

Length Inches	Number of Fish					
	Longear Sunfish	Redear Sunfish	Bluegill Sunfish	Large mouth Bass	White Crappie	War- mouth
1.0	....	....	....	....	....	....
1.5	0.2	....	....	1.3	....	....
2.0	1.0	1.0	5.3	4.0	0.2	....
2.5	0.8	0.7	2.7	2.3	....	....
3.0	2.0	0.8	1.2	1.3	....	....
3.5	0.8	1.2	0.2	0.5	....	0.2
4.0	....	0.5	....	0.7	....	....
4.5	....	0.2	....	0.3	....	....
Total	4.8	4.3	9.3	10.5	0.2	0.2

*Each Sample—600 square feet per sample.



Electric seine as it appears in use.

Reproduction Study Chicot Lake

June 23, 1959

Average of Six (6) Samples*

Length		Number of Fish					
In.	Long-ear Sunfish	Red-ear Sunfish	Bluegill Sunfish	Green Sunfish	Large-mouth Bass	Black Crappie	War-mouth
1.0			40.0	....	0.3	....	....
1.5			1.0	....	1.2	....	....

2.0	0.7	....	3.0	....	1.5	0.3	....
2.5	0.7	....	1.7	0.2	0.5	....	....
3.0	1.2	....	0.3	0.2	....	....	0.2
3.5	0.8	0.2	0.5	....	....	....	....
4.0	....	....	....	....	....	....	....
4.5	....	0.5	....	....	....	0.2	....
5.0	....	0.3	....	....	....	0.2	....
5.5	....	....	....	....	....	....	....
6.0	....	....	....	....	....	0.3	....
Total	3.4	1.0	46.5	0.4	3.4	1.0	0.2

*Each Sample—600 square feet per sample.

Reproduction Study Lake Providence

June 26, 1959

Average of Five (5) Samples*

Length	Number of Fish		
Inches	Longear Sunfish	Bluegill Sunfish	Largemouth Bass
1.0	.....	.....	.....
1.5	0.4	.....	0.4
2.0	0.4	1.0	0.6
2.5	0.2	.....	0.4
3.0	2.2	0.6	.....
3.5	1.8	1.0	.....
4.0	2.6	.....	.....
4.5	4.4	.....	.....
5.0	1.6	.....	.....
Total	13.6	2.6	1.4

*Each Sample—600 square feet per sample.

FISH FOOD STUDIES

Fish food studies are conducted by the examination of the contents of fish stomachs. These contents are identified and counted. With this data, fisheries personnel are able to show a correlation between the bottom fauna present in the lake and the food utilized by the fish.

Of the thirty-five (35) stomachs of the fish taken from Caddo Lake, more than 1,300 mayfly nymphs (Ephemeraidae) have been found. There has also been a large number of Tendipedidae, Culicidae, Tubificidae, and Tolitridae recorded.

POPULATION STUDIES

It is one of the aims of Fishery Biology to create and to maintain the maximum possible standing crop of fish with a balanced population of forage and predaceous species, thereby, assuring the greatest possible and continuing yield to sport and commercial fishermen. Thus, it is of great importance to know the fish population in order to serve this purpose. The following table gives a comparison of the total fish production of 1958 in each of the study lakes:

Body of Water	Type of Lake	Acres	Total lbs. of fish per acre
Caddo Lake	Non-fluctuated lake	*13,250	44.5
Cane River Lake	Old River lake	1,044	202.9
Chicot Lake	Fluctuated lake	2,500	19.1
Lake Providence	Mississippi River ox-bow lake	2,268	301.9

*Only the portion of Caddo Lake in Louisiana is included in this study.

DINGELL-JOHNSON PROJECT F-7-R LAKE D'ARBONNE AND BUSSY LAKE INVESTIGATIONS

JAMES T. DAVIS

Project Leader

J. S. HUGHES

Assistant Project Leader

The successful management of large impoundments for continued fishing success has proven to be a problem for fisheries personnel in Louisiana as well as in most of Southeastern United States. Impoundments receive the major fishing pressure for most of this state. Therefore, it is imperative that management techniques be studied and the best



Janice Hughes, Ass't. Project Leader on F7R, preparing distilled water prior to conducting chemical analyses of lake waters.

available be applied to our Louisiana lakes.

Two large lakes, Lake D'Arbonne and Bussy Lake, 18,000 and 2,200 acres respectively, will undergo extensive study to determine the most effective management techniques. No report is presently available, as the study was not initiated until October, 1959.

Bussy Lake in Morehouse Parish, near Bastrop, is the property of International Paper Company. It was completed in 1958 and filled in the spring of 1959. The company has completed a cooperative agreement with the Commission for fisheries management which includes a provision for public use. Accordingly, the lake was stocked with bass and bluegill in 1959. It is expected that the lake will be ready for fishing by the public in the late spring of 1960.

Lake D'Arbonne, located in Union and Lincoln parishes, near Farmerville, is not yet completed. Upon completion it will be stocked and opened for fishing the following spring. This large lake is expected to draw many fishermen to the area and should provide needed additional revenue to this two-parish section.

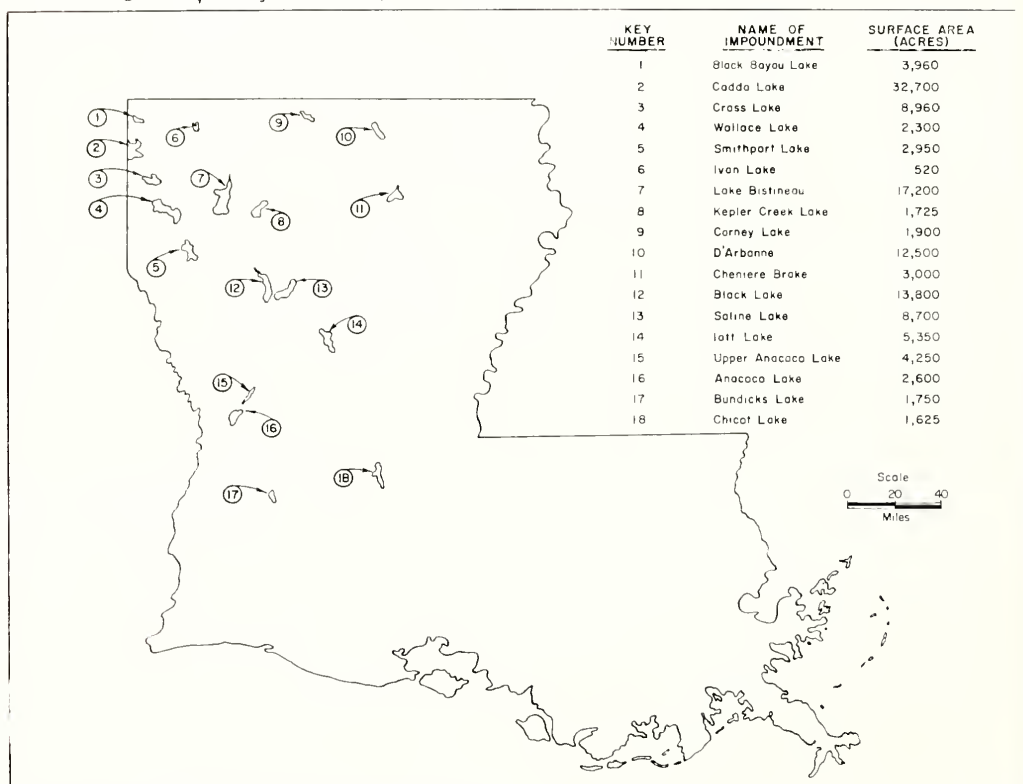
Many phases of lake management will be studied

under this project. The hot controversy as to whether trees should be left standing in the lake basin will receive prompt attention. What causes many lakes to suffer a decline in fishing success after five years will be studied. This is a rather complex problem and the solution may require some experimentation. Fluctuation of water levels for weed control and fish management will be a somewhat easier problem of study. Many other problems

will come up for study and as each is completed reports will be prepared and distributed. One final item will receive considered attention. This is, "what can a community and the state expect in the matter of increased revenues from the construction of such a large lake?"

These problems of lake management are to be studied. From this project will come the basis for lake management in Louisiana in years to come.

Louisiana, showing location of impoundments.



GAME SECTION

JOHN D. NEWSOM
Coordinator and Supervisor

CHARLES R. SHAW
Ass't. Coordinator



JOHN D. NEWSOM

Activities of the Game Section during the past two years have largely been carried out through the Federal Aid (Pittman-Robertson) program. Under this program, the federal government, through the Bureau of Sport Fisheries and Wildlife, the supervising agency, allocates a certain amount of money to each state on an annual basis, for the purpose of conducting wildlife restoration work. This money must be matched on a basis of three-fourths federal to one-fourth state.

In order to qualify for these funds, detailed budgets and work plans must be submitted annually to the Regional Office, Bureau of Sport Fisheries and Wildlife, prior to July 1. Approvability of the various projects is based on substantiality of character and design of individual projects toward the accomplishment of worthwhile goals in wildlife restoration. Projects may be in the form of research and development or management.

During the past two years, Louisiana has continued its program of investigations, development and management for all major species of game birds and animals in the state, with particular emphasis on deer and waterfowl.

As in the past biennium, the investigations project W-29-R has been concerned primarily with the accumulation of management information. This information is of the type that is needed annually when harvest regulations are being considered. Certain studies have been designed and are being conducted along lines which will augment basic knowledge about certain species. It is felt that expansion of the investigations program should be in the direction of the latter.

Development and management activities have been conducted under project W-30-D in the upland areas and under projects W-31-D and W-33-D in the marsh.

Upland game development and management work now in progress consists of deer trapping and transplanting, quail development and operation of man-



CHARLES R. SHAW

aged hunts for squirrel, deer and quail on management areas. Marshland waterfowl development is being conducted on about 70,000 acres of marsh under lease to this Commission in Lafourche and St. Bernard Parishes.

The following reports on various project work will provide detailed information on the various work being done by this section.

STATEWIDE WILDLIFE RESEARCH PROJECT W-29-R

ROBERT E. MURRY
Project Leader

Any discussion of wildlife research should be prefaced by a brief look back into history of man's search for knowledge regarding wildlife.

In this country the pioneer settler rapidly acquired knowledge regarding the forests and streams. His knowledge often greatly affected his chances for survival. Development of knowledge and skills was largely along the line of becoming more proficient as a harvester of the fruits of the forest, stream or lake.

Early settlers fresh from heavily settled European countries, where the game belonged to the land holding nobility, were strangers to the new philosophies of plenty and public ownership. The art of taking game and fish grew rapidly because there was a demand for such an art. The art of conserving the bountiful supply of the new land did not develop so rapidly because there was not the widespread demand for conservation.

An awareness of the need of conservation came only when people could see the brink of depletion. Of course, it is well recorded in the pages of history how the axe and the plow made gross changes in the habitat of the wild animals of this country. History does fail to mention that the changes which were so hard on the gray squirrel and the passenger pigeon worked to the advantage of the cottontail rabbit and the mourning dove.

The first efforts at conserving game came in the form of laws enacted regarding seasons for taking game birds and animals. These early laws were not met with much opposition since for the most part no provisions were made to enforce them. Later changes brought better enforcement and more and more restrictive laws.

Along with the public concern for our natural resources there developed a few "professionals," usually men trained in some related field who, through their high degree of interest in wildlife made searching studies of wildlife problems. Some of these people were interested laymen as was Theodore Roosevelt. Some were trained foresters as were Aldo Leopold and Herbert Stoddard. Others trained in zoology, botany, ornithology, etc. have made outstanding contributions in wildlife research. There has been a tendency in recent years for people to specialize in the field of technical wildlife training to the point that they earned degrees in this field of study. Since college degrees in game management have been awarded a scant quarter of a century many of the older professionals in this country today were trained in some related field.

As is noticeably true in other technical fields, wildlife is beginning to reach the point of specialization within the profession. While this is not yet as apparent as specialization in the fields of agriculture and forestry this trend can be expected to continue as we place more demand on the same old areas to produce more and more recreation-wise for an expanding population.

Wildlife research has some things in common

with research in the other biological sciences, but some of the differences are outstanding. The forester marks his study plot and it is identifiable for years, the agronomist carefully treats his plots and measures the yield with precision and the student of animal nutrition has his herd under careful control. The research biologist dealing with wild dynamic game populations must use considerable ingenuity in devising workable ways to measure population changes.

There have been developed techniques usable in separating adults from young-of-the-year of several game species. To the writer's knowledge, none of these techniques were developed in Louisiana. Fortunately, the rapid exchange of information within the profession has served to keep Louisiana workers abreast of the most recent developments. Recent technical advances are learned through the large volume of literature currently being published and through an exchange of information which takes place at meetings arranged for the purpose of bringing professional wildlife people together.

Wildlife research was at one time confined largely to universities, the Fish and Wildlife Service and a few of the states fortunate enough to have the financial ability to support research programs. The enactment of the Pittman-Robertson Act, known as the Federal Aid to Wildlife Restoration Act, with a supply of matching funds for approved projects, put wildlife research within the grasp of most all state game budgets.

Some states desired information regarding management problems that were brand new. Often they jumped into research to get new answers for these new problems with equally new personnel. Sometimes the immediate results were less than anticipated, yet some of the avenues of knowledge opened by early P-R research have proved of utmost importance.

In Louisiana the P-R program is probably better known for the excellent showing that has been made with development work. Two of the best known examples are the many fine game management areas established and operated under the development phase of the P-R program and the rapidly growing deer herds established by this program.

The research contributions of the Federal-Aid program in Louisiana are less well known. Two important early projects were a study of muskrats in Louisiana marshes and a study of the survival rates of pen-reared quail. More recently Louisiana has had an important role in the Southeastern Cooperative Dove Study. More liberal harvest regulations which resulted from the findings of this study have provided many thousand man-days of outdoor recreation.

In addition to independent deer and waterfowl research the P-R Section is also engaged in a cooperative study of deer diseases with other southeastern states and in a closely coordinated Mississippi Flyway Waterfowl study. Other research programs, while contained entirely within the state, depend upon a large number of employees and often volunteer hunters for research data. Information and advice are sought from universities, research personnel of other agencies and game departments

of other states. The research employee finds himself engaged in a battle to keep abreast of recent developments in a world where emphasis is to be placed more and more on scientific research.

Since all research, worthy of the name, follows a carefully designed procedure, good planning is required if quality results are to be expected. To be of use to a wildlife program research must be directed at current problems. Results should be useful to the agency in formulating policy, making regulations and planning development. Much of the more basic research, such as life history studies, etc., has been conducted by universities and study foundations. This has enabled state wildlife agencies to confine their research efforts to problems with more direct bearing on management needs.

The Louisiana Wild Life and Fisheries Commission has seen the need to place research personnel on assignment as free as possible from the duties of management, development, public relations, enforcement, etc. So far it has been impossible to use research personnel exclusively for research because of the never-ending series of projects, problems and crash programs all with manpower needs which seem to require the services of exactly all the available personnel. As this situation improves, parallel improvement is expected in the quality of research.

The immediate aims of our research program can be enumerated as follows:

1. To carefully search all previously completed research projects, both published and unpublished, for data usable for management, current research or popular publication.
2. To take stock of current research to assure a high standard of quality.
3. To inventory past research and research in progress against the needs of management so that future problems can be assigned a priority based on our need for the answers as well as our capabilities to undertake the work.
4. To plan future research along sound lines where the project objectives will be readily attainable and the attainment of these objectives will result in valuable additions to our storehouse of wildlife management knowledge.
5. To publish technical information in available technical outlets and to make research information available to the legislature, the commission and to the sportsmen of the state through non-technical publications.
6. To fulfill our obligations to the Federal Congress by obtaining prior project approval and by furnishing the required project reports so that obligated federal funds will not be withheld.

DEER INVESTIGATIONS

LOUIS E. BRUNETT
Study Leader

DAN DENNETT
Ass't. Study Leader

Deer Hunts on the Game Management Areas

During the 1959 deer hunting season there were 10 Game Management Areas open. These areas com-

prised approximately 210,000 acres or twice the amount open in 1958. The five areas open in 1958 had approximately 11,500 hunting efforts and in 1959 it increased to 31,926. Those hunting the five areas in 1958 bagged a total of 350 deer. In 1959 there were over five times as many deer killed for a total of 1,870.

The first any-deer hunts to be conducted in Louisiana were held in 1959 on six Game Management Areas. However, these any-deer hunts should not be confused with the first antlerless deer hunt that was held on the Chicago-Mills Game Management Area and in other portions of Tensas Parish in 1958.

The any-deer hunt on the Red Dirt, Catahoula, Evangeline, Jackson-Bienville and Chicago-Mills Game Management Areas was conducted in an effort to bring the deer herds into balance with the range. The range on these areas has been overbrowsed. This condition has been existing on some areas longer than others. The ideal method of deer management is to avoid this overbrowsed condition on an area and to harvest the annual increment (annual reproduction) as the area approaches carrying capacity. In order to harvest the annual increment, areas are opened to hunting, using certain control measures.

Most of the deer on some of these areas were fat. Hunters may say "Well, the deer were fat; the area must not be overbrowsed." The hunter must remember that there was a good acorn crop for 1959. The deer stomachs opened contained many acorns. These acorns account for the layer of fat on those deer. After the acorns are gone the deer will again have hunger pains because the browse is gone.

The any-deer hunt is not a tool of management to be used every five or ten years, but should be carefully considered on an annual basis. Close supervision of any-deer hunts should be maintained to keep the number of deer killed under control.

The any-deer hunt on Sabine Game Management Area No. 11 was conducted as an effort to maintain the herd within balance of the range. This range is not overbrowsed, but it is approaching carrying capacity. Any time an area is opened to deer hunting, the hunt should be regulated to take deer of either sex.

Some people may think that all of the deer on those areas opened for an any-deer hunt have been wiped out. Observations for deer sign (tracks and droppings) on those areas after the any-deer hunts show that there are still plenty of deer there.

The areas, the number of hunting efforts and the number of deer killed are as follows:

	<i>Hunting Efforts</i>	<i>Deer Killed</i>
Red Dirt	7,616	337
Catahoula	6,390	354
Evangeline	3,132	113
Grant-Rapides	1,014	35
Sabine No. 2	898	21
Jackson-Bienville	4,242	325
Union	1,194	20
West Bay	2,760	72
Zemurray Park	280	27
Chicago-Mills	4,400	566
TOTAL	31,926	1,870

Crop and Forest Reproduction Depredation by Deer in Madison and Tensas Parish

Damage to farm crops and forest reproduction in Madison and Tensas Parishes has been occurring for several years by the over-populated deer herd in those two parishes. The problem of a large deer herd versus crop damage is not a new one. Other states have been experiencing this problem for many years and have tried many different methods in an effort to cope with this problem. Various methods, including repellents, firecrackers, dogs, etc. have been used in an attempt to keep deer out of crops in this area; not one has been successful.

The disastrous flood of 1927 almost wiped out the deer herd in this area. Many of the officials and



Soybeans eaten by deer in Madison Parish.

people of Tensas Parish fed and cared for the few remaining deer. The season was closed for a few years thereafter. This was the beginning of the herd that grew to its present status.



Cotton browsed by deer in Madison Parish.

Ideal conditions for deer developed following the cutting of virgin hardwood forests in this area. After the timber was harvested high quality food was abundant in the form of shrubs, hardwood seedlings and sprouts which followed the opening of the forest canopy. This flood plain type of soil is



Corn browsed by deer in Madison Parish.

very rich and can support a tremendous amount of vegetation.

The deer herd in Madison and Tensas Parishes began to increase very rapidly through the late 1940's and early 1950's. Crop damage problems began to occur as heavy browsing by the overpopulation of deer greatly depleted available food supplies in the forested areas and the deer were forced out upon farm crops for food. Crop damage began to occur in the 1940's but the severity increased annually.

Crop damage surveys have been made by technicians of the Louisiana Wild Life and Fisheries Commission since 1954. Since that date, damage to crops in Madison and Tensas Parishes has become more severe each year. It would be hard to estimate the total damage in dollars and cents; however, in 1957 approximately 25 farms, in Tensas Parish, ranging from 100 acres to 6,000 acres in size were surveyed by biologists of the Commission. Of the 25 farms surveyed, crop damage estimates were received from 15 farms. The estimated annual deer damage on these 15 farms was approximately \$60,000. In a number of cases, especially on smaller farms, farmers have been forced to switch from soybeans to some other type of farming in order to survive. The small farmer in Tensas Parish is almost a thing of the past.

Practically all crops grown have received some damage, however, some are damaged more than others. Cotton began to receive severe damage in 1957. Up until that time the damage was confined primarily to bolls which were bitten by deer and shattered from the plants as they walked among them. In 1957 deer began to eat young cotton plants when they first emerged. This was on a limited scale but it increased in 1958 and '59.

Deer walk the rows of young plants eating the stems and pulling many from the soil. This browsing continues on the plants until they reach maturity and then the squares and bolls are eaten and

shattered from the plants.

Soybeans are browsed the heaviest of any of the farm crops. When soybeans first emerge from the soil deer walk the rows eating the young tender plants. The plants are continually browsed until the fruit is mature; then the mature fruit (beans) is consumed.

In the past, corn received damage from the roasting ear stage until maturity. In 1957 some plants received minor damage before the roasting ear stage. In 1958 and 1959 corn plants were severely damaged.

In the winter deer will graze on wheat and oats but as long as the soil is dry this grazing seems to benefit these crops, because it causes them to sucker out. But if the soil is wet, plants are trampled into the soil. Damage to other grain crops is insignificant.

The pastures and cover crops are grazed but the amount of damage caused is harder to accurately evaluate.

Family gardens and even shrubs around home sites have received severe damage from browsing deer.

The extent of crop damage, by browsing deer, is depicted in a series of photographs, Figures 3, 4 and 5.

Farmers of the area are not the only ones receiving damage from deer. Forest reproduction has been heavily browsed. Most forest reproduction is less than two feet high and the next largest size class is three to four inches D.B.H. From the browse surveys that have been conducted for the last three years, those browsed heaviest are: hackberry, water oak, willow oak, black locust, green ash, and nuttall oak.



Mr. B. L. Dubois with buck killed on the Red Dirt Game Management Area during the controlled hunt in November 1959. The collar on the deer's neck was attached for a research study on deer movement.

Studies of Movements of Deer

Studies to determine daily range and seasonal movement of deer are being conducted on Red Dirt and Evangeline Game Management Areas.

During the trapping operation of 1957-58 on the Red Dirt Game Management Area, 51 deer were marked and/or ear tagged and were released at the trap site, 31 were branded on both sides with a commercial branding fluid, eight were marked with plastic covered leather collars and the remaining 12 were just ear tagged. During the 1958-59 trapping season, some of the deer that had been marked with the commercial branding fluid were retrapped and also during the controlled deer hunt in December 1958, two of the marked deer were killed.

During the deer trapping operation of 1958-59 on Red Dirt, 39 deer were marked and/or ear tagged and released at the trap site.

The Need for a Tagging System

All deer research is conducted with one common goal—to gather as much information as possible so that we may manage our deer herds more effectively and judiciously. Season limits and hunting seasons are necessary evils that contribute some control to prevent the taking of too many animals from our deer herds, but are not adequate enough measures with which we can control deer killed in view of the increasing numbers of hunters. At the present time we have no accurate way of knowing how many deer are taken from a given deer herd with the exception of the game management areas. The total statewide kill is unknown. This sort of information is a *must* in order that we may apply the fruits of our research to a more realistic management program. Perhaps we have too short a season in areas that could safely stand more hunting pressure and, on the other hand, perhaps we have been too lenient on seasons in other areas that are in danger of too great a harvest. An accurate kill figure from the areas in question would supply the necessary information with which we could regulate seasons. This is just one example of how an accurate kill record could benefit the Louisiana hunter.

The answer to our problem is a relatively simple one. Louisiana is in desperate need of a tagging system. It is one of the few states in the union that does not have some form of tagging system. Basically, it would insure that each license holder could kill only the prescribed season limit and would require a return of some type of self-addressed forms to the Wild Life and Fisheries Commission stating where the deer were killed. The Commission is in need of this type of information.

As the deer of our state become more numerous and the trend toward outdoor living continues, we will be faced with ever increasing pressure on our deer herds. We must accumulate as much information about our deer as possible in order to manage them properly. Probably the most important management tool we could have would be the tagging system. It should not be looked upon as something to further complicate the life of the Louisiana hunter, but as a tremendous step forward toward an im-

proved and realistic form of game management which we are ultimately going to have to accept. Deer hunting can not survive the increasing demands without employing all of the management principles that are known to us.

Revegetative Study of the Deer Corrals at Red Dirt Game Management Area

Two forty-acre deer enclosures, or corrals, were constructed on the Red Dirt Game Management Area in 1951 with the objective of determining annual increment; carrying capacity; key browse species; longevity of specific plants; and the effect of prolonged browsing on plants. The enclosures



Yaupon, a preferred deer food, that has been heavily browsed by deer. Note the hedged effort on this plant.

were set up on areas that were typical of conditions throughout the game management area. The south corral was stocked with two does and the north corral with a buck and a doe.

In 1957 it was determined that this study had served its purpose; subsequently the deer in each corral were trapped and released on the area. Before the deer were removed both corrals were considerably overused.

The present study was set up to determine how long it would take an overused deer range, of this particular timber type, to recover.

In the spring of 1958 the existing 20 permanent mil-acre plots in both corrals were checked. The number and height of stems for each species was recorded in the height classes of 0-2, 2-4.5, 4.5-7, and 7-12 feet.

The check of 19 plots in the north corral in 1958 revealed 142, 62, 38, and 17 stems in the 0-2, 2-4.5, 4.5-7, and 7-12 foot height classes respectively. This amounted to a total of 259 stems. The checks in 1959 revealed 291, 80, 40, and 30 stems in the 0-2, 2-4.5, 4.5-7, and 7-12 foot height classes respectively for a total of 441 stems. In 1959 the greatest increase in the number of stems appeared in the 0-2 foot height class. In 1959 there were more than twice the number of stems in this height class than were present in 1958.

The north corral was burned prior to the stem check. The fire could have influenced the number of stems. While a firebreak was being plowed on the inside of the corral, the tractor and fire plow made a furrow through one plot and this plot was not

used.

The results of the permanent plot checks in the south corral in 1958 were 85, 62, 70 and 18 stems for the 0-2, 2-4.5, 4.5-7, and 7-12 foot height classes respectively. This amounted to a total of 235 stems in all height classes. The checks of 1959 revealed 279, 100, 70, and 17 stems for the 0-2, 2-4.5, 4.5-7, and 7-12 foot height classes respectively. This was an overall total of 466 stems or an overall increase of nearly 100 percent.

The 279 stems in the 0-2 foot height class in 1959 were more than three times the 85 counted in 1958.

An example of the way that new plants come in is well illustrated by the various plots and by the



Blackgum that has been heavily browsed on the Zemmurray Park deer management area.

stem counts. Vegetative growth was probably influenced by the wet growing season of 1958.

In addition to checking the recovery of the vegetation in the overused corrals, one corral was burned in 1959 according to United States Forest Service recommendations. The purpose of the burning was to determine effects of prescribed burning on deer browse species. After burning, five plants each of yaupon, redbay, and whitebay were selected for study. Since a characteristic growth habit of whitebay is to grow in clumps, five clumps of it were selected for study.

The plants burned have put on some luxuriant growth in the form of sprouts. At the end of each growing season the number of new stems will be counted and also the length of each will be measured.

In an effort to determine the required height and angle to cut woody browse species to produce the best sprouting, 120 plants in the corrals were treated by cutting. Five plants, each of yaupon, gallberry, redbay, and whitebay were cut parallel to the ground at heights of 6, 12 and 18 inches. Five plants of each of the above species were cut at a 45 degree angle to the ground at heights of 6, 12 and 18 inches. After each growing season the number of sprouts will be counted and the total length of each recorded.

Cooperative Deer Disease Study

This phase of the deer study was added in 1957 with the objective of determining the cause or causes of deer disease outbreaks in the southeastern states and to devise control measures where possible.

It is a cooperative effort between eleven southern states and the University of Georgia. It was felt that the desired information could best be obtained by an agency such as the University of Georgia School of Veterinary Medicine, which is equipped and staffed to conduct intensive studies.

The infectious phase of the procedures used will be conducted by Veterinarians and Pathologists from the University of Georgia and state personnel. Visits are made to areas where deer are dying from unknown causes, necropsies are performed and tissue specimens collected for bacteriological, viral, mycotic, and parasitological studies. Histopathological studies are made of all tissues collected. Transmissibility tests of the disease are made on deer, small laboratory animals, and domestic goats and sheep. The carriers and vectors of the diseases encountered are determined as far as possible.

The toxicological phase of the procedures are conducted by making collections of known poisonous plants where deer are dying and necropsy indicates that death was related to poisoning. The ingesta of the necropsied animals is chemically analysed. The poisonous plants are fed to deer, goats, and sheep to reproduce the syndrome. The plants are chemically analysed and their extracts given to deer, small laboratory animals, and domestic sheep and goats.

The nutritional phase of the procedures is conducted by determining the vitamin A content of the blood and the calcium and phosphorous content of the blood and bones.

In July, 1958, an anthrax outbreak occurred among cattle in Madison and Tensas Parishes. At one time 11 parishes in the area surrounding those two parishes were under quarantine. On the Somerset Plantation in Tensas Parish, 35 cows, two hogs and eight deer were found dead. An ear was collected from one of the deer and sent to the W. E. Anderson Diagnostic Laboratory at Baton Rouge, Louisiana. The report on it was positive to anthrax.

During this time, reports of a deer die-off in Madison and Tensas Parishes began to come in. An investigation by Commission Biologists and Refuge Supervisors was conducted that included checking 92 miles of the Tensas River, a check of jeep roads, logging roads, old dummy lines, checks of small canals and bayous by walking, checks with farmers, foresters, logging crews, construction crews and survey parties. No dead deer were found nor had any one contacted found any.

In 1958 the Louisiana Wild Life and Fisheries Commission collected 66 deer blood samples from Tensas Parish and three from the Red Dirt Game Management Area and sent these to the Cooperative Deer Disease Study. Of those 66, three were positive to leptospirosis, and one to *Brucella abortus*.

During 1958-59 the Commission was to furnish the Cooperative Deer Disease Study 500 blood samples from deer. There were 357 samples furnished the study and two of those were positive to *Brucella abortus* and one was a suspect.

Of the 39 released at the trap site, six does and 27 bucks were marked with plastic covered leather collars and the remaining six bucks were just ear tagged.

In early November 1959, one buck with collar was

found dead on Red Dirt. The cause of death could not be determined.

All of the traps on Red Dirt are permanently located and have been plotted on a map. Sight records are kept on the marked deer. The location of each sighting is plotted on the map.

During the controlled deer hunt on Red Dirt in 1959 there were 31 marked and/or tagged deer killed. The kill location of each of those was plotted on a map.

On the Evangeline Game Management Area, in the winter of 1958-59, a trapping operation was conducted to mark and/or ear tag deer. The deer were marked with plastic covered leather collars of various colors and color designs. During the trapping operation, 13 deer were trapped, marked and/or ear tagged and released at the trap site. Of the 13 deer trapped, 12 were ear tagged and marked with plastic covered leather collars and one was just ear tagged. Eight of the deer were retrapped from one to three times. During the controlled deer hunt on this area in 1959 four of the marked and/or ear tagged deer were killed. The kill location of those was plotted on a map.

Reproductive Studies of the White-Tailed Deer

By the examination of reproductive tracts taken from female White-tailed Deer we can learn several important things. Primarily, we are able to determine the approximate amount of fawn production for the present breeding season, the approximate fawn production for the immediate past breeding



Biologists preparing to remove reproductive tract from doe on Chicago Mills Game Management Area.

season and the period at which breeding in any given locality is at its peak. Dietary deficiencies will be reflected in lowered total fawn production. This is the basic principle upon which the reproductive study is based. Simply, deer from poor range will have fewer fawns than deer from good range. As deer populations pass their peak and the range is gradually destroyed the fawn crop becomes smaller. From the examination of the reproductive tracts from a given deer herd we are able to tell if the animals of that herd are in the proper condition.

Since the spring of 1958, a total of 164 repro-

ductive tracts have been examined. They have been taken from Tensas Parish, Madison Parish, Red Dirt Game Management Area in Natchitoches Parish, and West Bay Game Management Area in Allen Parish.

The managed "any-deer" hunts on several of the game management areas in the fall of 1959 provided quite a number of reproductive tracts which as yet have not been examined but will doubtlessly yield a large quantity of management information.

Yearly checks on the reproduction of the various herds will keep us more accurately informed as to the condition of the herds, thereby allowing us to manage them more effectively.

Summer Food Habits of Deer Utilizing Exlosures and Inclosures on Vegetational Sampling

The objective of this job of the deer study is to determine the relative importance of herbaceous shrubs, vines, and trees in delta hardwood types for deer foods and the extent of damage of deer browsing on hardwood reproduction.

This study is being carried out on the forest of Fisher Lumher Company in Tensas Parish. Six exlosures 80 feet by 80 feet in size were constructed in the summer of 1956. Adjacent to the exlosures a control area was set up. There are two exlosures and controls set up for each of three types of overhead canopies. The three types of canopies are open, medium, and heavy.

The check on the exlosures in the spring of 1959 was the second one since construction. However, this was the third growing season. The checks are made by the use of a regular surveyors chain laid out full length, diagonally, across each exlosure and its control. The surveyors chain is 66 feet long, and is graduated into 100 link graduations. Each species of forb and woody stem is counted and the height recorded in two foot intervals up to six feet, for a two link width over the length of the chain.

A general observation in the early spring of 1958 and 1959 showed that deer were browsing heavily on important forest reproduction species along with the other vegetation.

The total number of plants in forbs and woody species for 1959 increased over 1958 in the exlosures as well as the controls. The woody species of plants on the controls had been browsed heavily by deer. This heavy browsing has caused those plants to take on a hedged appearance. Those plants on the controls, that have been heavily browsed, have the main stem bitten off and many have put out a new main stem. Those plants will not grow into good merchantable saw logs.

WATERFOWL INVESTIGATIONS

MORTON M. SMITH
Study Leader

The Louisiana waterfowl study was initiated in July, 1949, and has been in continuous operation since that date. The objective of this study has been to obtain the information needed to provide the best possible hunting for the state's waterfowlers, within



Mallards over the timber near Monroe, Louisiana.

those limits imposed by federal regulations. Over the years a great deal of data have been gathered from both ground and aerial surveys. Many biologists and field personnel of this Commission have assisted in the collection of the information. The activities of the waterfowl segment during 1958 and 1959 are described in the following report.

Waterfowl Population Studies Habitat

The important waterfowl wintering areas in the southwestern part of the state have undergone considerable change since the early years of this study. The most important areas, Cameron and Vermilion



Wood duck clutch in a nest box on Lake Bistineau.



Blue wing teal nest and eggs on Grand Chenier.

parishes, still show the effect of Hurricane Audrey which swept through in June of 1957. From a waterfowl standpoint the changes wrought to date have been beneficial. Much of the marsh area has been opened up and each season has seen a tremendous crop of wild millet, a choice duck food, produced. This abundance of food has been one reason that duck populations in southwest Louisiana in 1958 and 1959 were the highest found anywhere during this study.

In southeast Louisiana the upper marshes produced some of the best stands of aquatics we have seen. The high rainfall of the last two years may have been responsible for the good food conditions there.

The delta marshes at the mouth of the river are much improved and have recovered in part from the nutria eat-out of the mid-fifties and the hurricane of 1956.

Conditions in central Louisiana on Catahoula Lake varied. In 1958 the backwater remained high all fall and waterfowl populations were low. In 1959 water levels were low and the duck population was up. A small flock of geese remained on the lake during the fall of 1959.

In north Louisiana habitat conditions for waterfowl during 1958-59 were, in general, satisfactory. Duck hunting was not as good as that reported in some earlier years, however.

Censuses

The size and location of the statewide waterfowl population is determined by aerial inventories run once or twice each month from September through May. These inventories have been carried on since 1951 and information on the distribution, time of migration, local movements, and availability of the various ducks and coots to the hunter is being collected. Such information is needed in order to better set seasons and formulate needed regulations.

The census information is gathered by aerial checks of known waterfowl concentration areas and

from regular routes flown over the coastal marsh. The study leader and Commission pilot, Nelson Summerell, fly these routes at low altitude and speed and record the ducks, geese, and coots seen. State-wide populations are then estimated from these recorded figures. The inaccessibility and size of much of the state's waterfowl habitat and the distance covered during surveys make an airplane essential in this work.

The early surveys in September of 1958 and 1959 found the usual blue winged teal, shoveler, and pintail flocks in the coastal marshes.

By mid-October in 1959 a large pintail concentration was forming on Catahoula Lake, due to the better water and food conditions. At the same time coot (*poule 'deau*) numbers were building up in the coastal marshes.

In late October of both years a large migration of ducks and geese arrived in Louisiana. The blue and snow geese are our most regular migrants and the majority of these geese arrived between October 20th and November 3rd each year. The population totaled approximately 400,000 birds in 1958 and 1959.

During this same late October and early November period, large numbers of gadwall, baldpate, green winged teal, shoveler, pintail, and scaup (*dosgrís*) arrived. We have come to expect this late October-early November flight after watching it for several years now. There was an increase in mallard numbers, but the biggest flights of mallards did not arrive in the state until late November and early December in both 1958 and 1959.

In 1958 duck numbers gradually declined through the spring and reached a low point by late May. Most of the ducks departed in February and March and the big flights of geese left in March. The tremendous population of scaup (*dosgrís*), many of which are found in gulf waters, seemed to leave our state in March also. The spring migrations of the last two years are about the same as those observed in earlier years.

During both years, the state waterfowl population increased in size as winter progressed. In 1958, at peak numbers, over 4,000,000 waterfowl were found and a similar number were counted in early December of this year.



Aerial census of Wham Brake.



Biologist, Bob Kimble, banding wood duck near Minden, Louisiana.

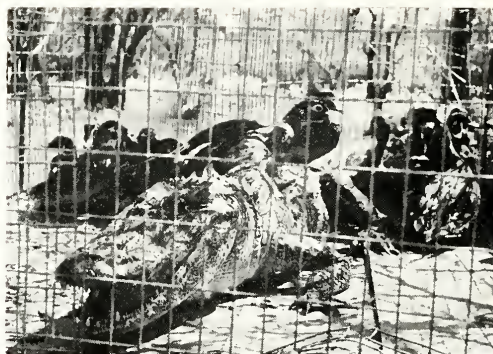
Production Studies

In addition to the winter counts, surveys are made of the mottled duck (black mallard or summer duck) and the wood duck—both of which breed in Louisiana. An aerial survey is run in June and August in an attempt to estimate mottled duck production.

It appears that the last two years have been most favorable for mottled ducks and the population in 1959 was probably twice that found during the mid-fifties. To the best of our knowledge, the generally wet seasons, excellent food conditions, and the reduced number of predators during the last three



Biological Aide, Charles R. "Chili" Baur building wood duck trap.



Seven foot alligator and fifteen wood ducks in a trap used to catch ducks for banding on Black Bayou.

years have been responsible for the increase.

There was also a gain, although not as spectacular, in the state's wood duck numbers over the last two years. Populations of the wood duck are reported to be up all over the Mississippi Flyway. Our estimates in Louisiana are based on nesting box checks and reports on this species from field personnel.

Cooperative Studies

It has become more apparent with each passing year that in studies of migratory birds the various states and agencies must enter into cooperative projects if full value is to be received from the efforts put forth. It is a credit to our state that this Commission has joined, and is participating in, a series of these flyway-wide studies of waterfowl. Under such cooperative programs we benefit from the experience and facilities of other agencies. The end result is better data at less cost.

Most of these works are carried out under the direction of the Mississippi Flyway Council—an organization composed of representatives of the fourteen states in the Mississippi Flyway.

Banding

In an effort to provide information needed to better manage our waterfowl Louisiana banded ducks within the state and assisted in the cooperative banding program in Canada.

Few ducks were banded in 1958 in Louisiana, but a major effort was made to band wood ducks in Louisiana during 1959. Because of the hard work and ingenuity of three biologists, Bob Kimble, Charles Baur, and Dewey Wills, a total of 535 wood ducks were banded in a three month period. Very few woodies had been banded previously and it was necessary for these men to learn where and when to set traps and how to bait the traps for best results. There were some interesting moments—as when a seven-and-a-half-foot alligator was found in one of the traps along with fifteen wood ducks.

This wood duck project was part of a similar effort in 1959 by a majority of the states in the eastern United States. In our flyway alone about five thousand wood ducks were banded this year. We expect to learn a great deal from this joint effort.

Another cooperative banding venture has been



Drive trapping ducks for banding in Saskatchewan, Canada. Over 1700 ducks were caught in this drive. Photo by U.S. Fish and Wildlife Service.

the Canadian Cooperative Banding Program, which has been in progress for five years now. In 1958 biologist Joe Herring worked in eastern Saskatchewan with a crew that banded over 2,300 ducks.

This year biologist Dick Roberts worked the same area with a crew that caught and banded over 2,000 birds. Both men reported serious drought conditions in the area worked which sharply reduced the number of birds available for banding.

A great number of ducks have been banded under the above research program. The information gained is shedding new light on many of the questions concerning waterfowl in our state.

Waterfowl Hunter Kill Surveys

In past years this Commission has run annual duck hunter bag checks at selected points over the entire state. Since 1950 upwards of 100,000 waterfowl have been checked by biologists of this Commission. A significant body of data on the state waterfowl kill has been amassed during this period.

Hunter bag checks were not made in the same manner in 1958 and 1959. Because the checks are expensive, and many biologists are needed on other studies during the winter, a new system has been started.

Under a recent agreement the U.S. Bureau of Sport Fisheries and Wild Life will conduct an annual

survey of the Louisiana waterfowl kill. A similar agreement has been completed by the Bureau with almost every other state in the Mississippi Flyway. Since trained personnel for such studies are scarce and expensive, we feel the information gained from this cooperative study will cost us only a fraction of what it would cost to go it alone.

Kill information gathered from the 1959 hunting season will appear in a future report.



Bob Chabreck, Biologist, and student checking a hunter's kill.

Wing, Bias, and Age Ratio Studies

These cooperative projects are companion studies to the kill survey reported on above.

Through techniques developed by ornithologists it has been found possible to tell the age and sex of some species of ducks simply by looking at their wings. In order to further this work wings from ducks of known age and sex are being collected at several locations over the state.

Another study is the collection of bag check information from a group of hunters that will later be questioned on the kind and number of ducks killed. The hunters' responses to the questionnaires will provide a series of bias factors needed by statisticians in order to properly evaluate hunter reports. This work is being carried out under the supervision of Mr. Allan Enslinger at the Pass-a-Loutre Public Shooting Grounds.

A first time study is the collection of data on the number of young versus old ducks that are being killed by hunters in this state. It is believed that such records will provide a check on conditions on the northern breeding grounds. In good years, there should be many young birds—in poor years there should be many old birds.

Reports received from the breeding grounds this year indicated the hatch may have been one of the worst since the mid-thirties. There was considerable controversy on this point and it was hoped the age ratios would throw more light on the subject.

Preliminary information gathered in Louisiana on over a thousand ducks indicates the hatch must indeed have been a poor one insofar as ducks visiting this state were concerned. In most species the number of old birds far exceeded the number of young ducks killed. This is the reverse of what is expected when breeding conditions are good. We think it is one reason the Louisiana hunter had such a hard time killing ducks this season. The ducks are simply old and more wary and are decoy and blind shy. Reports from all over commented on the difficulty of luring ducks into killing range during the 1959-60 season.

Depredations Study

Grainfield depredations are a problem that the average hunter in our state never hears about, but it is a matter that will be of more importance to him as the years go by.

Because of peculiar features of climate and habitat in parts of Canada, there are areas where waterfowl are considered an agricultural pest by the farmers. The ducks, under certain conditions, are able to cause considerable crop loss in the grain fields of some regions. To date the farmers, though unhappy, have taken little action against the ducks.

The problem is a serious one, however, and will grow worse as time passes. It has caused great concern among Canadian and U. S. waterfowl workers. States from the Mississippi Flyway have sent men to Canada for the last two years to participate in a series of studies that, it is hoped, will eventually lead to a solution of the problem.

In 1959 Louisiana sent this study leader to participate in the depredations study. The work was



A carbide operated zong gun used to scare depredating ducks from grain fields in Saskatchewan, Canada.

carried out in August and September in Saskatchewan. It is too early to report on the project's results, but methods of controlling duck damage in grain fields were tested that showed promise of alleviating the depredations in local areas.

Other Studies

There were other cooperative studies among Mississippi Flyway states on migration, available waterfowl habitat, the Soil Bank, pesticides, and other subjects. Louisiana participated in all these works and provided the necessary information from our state. One important phase was the review of all the Louisiana waterfowl habitat in the light of the recent increase in duck stamp funds earmarked for federal land acquisition.

A considerable part of the waterfowl study's efforts was directed towards the cooperative projects outlined above. It is from the results of such cooperative studies that we can hope to gain the information needed to better manage and harvest our waterfowl resource.

LOUISIANA WATERFOWL SITUATION

Present

The basic conditions of the Louisiana waterfowl habitat have changed but little during the last two years. Our state has nearly six million acres used by wintering waterfowl. Nearly a half million acres of this total are in refuges. Of these lands, 180,000 acres are in inviolate refuges managed by the Louisiana Wild Life and Fisheries Commission and 26,000 acres by the National Audubon Society. The remaining 240,000 acres are in refuges administered by the U. S. Fish and Wild Life Service. For the first time since their formation parts of the federal refuges can now be opened to public hunting.

The state is presently managing six areas as public shooting grounds for duck hunters. These areas are: Pass-a-Loutre at the mouth of the Mississippi River, Bodcau near Minden, the Shiloh

Creek and Bayou Lafourche areas near Monroe, the Wisner Public Shooting Area in lower Lafourche Parish and the Biloxi Public Shooting Area in St. Bernard Parish. The six areas total approximately 140,000 acres.

Management practices for waterfowl vary on the shooting grounds. At Pass-a-Loutre one remote section is open to unrestricted public hunting, while on the main area, there is a limitation on the number of hunters. A program to improve and preserve as much of the present habitat as possible has been instituted. Because of damages that result from the dredging necessary in oil and gas exploration and navigation channels, it is certain that more of the area will be reduced in value for waterfowl in the years to come.

The public shooting grounds near Monroe and Minden are being managed in accordance with a recommended plan. The major feature of the plan is a water draw down during the growing season to preserve the mast producing timber.

Development programs have just been initiated on the Biloxi and Wisner Public Shooting Areas. It is planned to improve the habitat of these marshes through the installation of a series of water control structures and earthen fills. The methods used are relatively new but, based on evidence from older areas, hold promise of providing a feasible means for improving marsh habitats for a variety of wildlife.

Additional acreage of some use to waterfowl is located in the large impoundments of Lake Bistineau, Black and Saline Lakes, Turkey Creek, Cheniere Brake, Anacoco, and Iatt Lakes. These areas are open to hunting but support only small duck populations. The areas are not managed for waterfowl.

Catahoula Lake, one of the finest waterfowl spots in the Mississippi Flyway, still remains in its original and most productive form despite continuing attempts to alter it in one manner or another. This 21,000 acre basin produces a great quantity of food and, in most winters, supports a large number of ducks. The entire area, with the exception of a thousand acre state refuge, is open to public hunting and is heavily utilized by hunters.

Of the six million acres used by waterfowl in the state about a million acres are open to the public hunter. Much of this area is of poor quality and the kill is low in most years. There is a real need for more good duck hunting areas in our state.

Duck hunting in Louisiana is big business. In 1958 there were over 100,000 duck hunters in Louisiana and it is estimated that these sportsmen spent in excess of \$17,000,000 on their sport. The recreational and esthetic values must also be added to this monetary value in arriving at the true worth of the resource.

Future

We are all aware of the great increases in human population and industry forecast for our state in the decades ahead. What steps can we take to insure the continuation of public waterfowl hunting in Louisiana?

1. In other states land is purchased and developed for waterfowl. In Louisiana it has been difficult, because of sub-surface values, to purchase large tracts of land. Nevertheless, we should make every effort to acquire lands that will be needed by future generations of hunters and fishermen.
 2. Where land is not for sale surface leases can often be obtained. While not as desirable as land purchase, land leasing will supply added hunting opportunity during the life of the lease. This has often been the only available way to acquire hunting areas.
 3. State owned lands presently under lease to private individuals for hunting should be converted to public use when the leases in force expire. A considerable acreage of land could be diverted to the public in this manner alone.
 4. This year, under a new federal law, the U.S. Fish and Wild Life Service can open limited portions of their refuges in Louisiana to controlled public hunting. The state should continue to strongly urge the opening of parts of these refuges, particularly those in southwest Louisiana, where public hunting areas are scarce. It would cost a great deal of money to acquire an acreage equal to that now available on the federal refuges under the new law allowing limited annual public hunting.
 5. In northeast Louisiana there are bottomlands suitable for waterfowl development. The Ouachita River system appears to be a migration route for mallards and waterfowl developments in the area are generally rewarded with good duck populations.
 6. Opportunities for improving waterfowl conditions in northwest Louisiana may be found in better management of the large impoundments along Red River. The best method of managing these areas is by an annual water fluctuation which can be expected to improve both fishing and waterfowl hunting.
- Other areas of bottomland exist in northwest Louisiana that can be developed for waterfowl. The Bodcau area near Minden is an excellent example of what can be done with bottomlands in that section.
7. Perhaps our greatest long term waterfowl need is for close planning with the various agencies engaged in drainage, navigation, improvement, and flood control. Often slight changes in planning can result in a project beneficial to wildlife interests, rather than destructive. In these developments emphasis should be placed on multiple use projects that benefit all, rather than single purpose plans that frequently have little regard for recreational opportunities or fish and wildlife values.

Progress has been made since the last Biennial Report. The acreage in public shooting grounds has doubled since 1957. Catahoula Lake remains a great waterfowl area and an important link in the Mississippi Flyway migration route. Through state and cooperative research studies we are getting a better understanding of the management of the resource.

We cannot be complacent however. The great human population gains predicted for Louisiana and the increased industrial activity forecast for the years ahead will require an all-out effort to retain public waterfowl hunting as we know it today.

The program outlined in this last section would do much to further public waterfowl hunting. The time to act is now.

MOURNING DOVE INVESTIGATIONS

JOHN D. NEWSOM

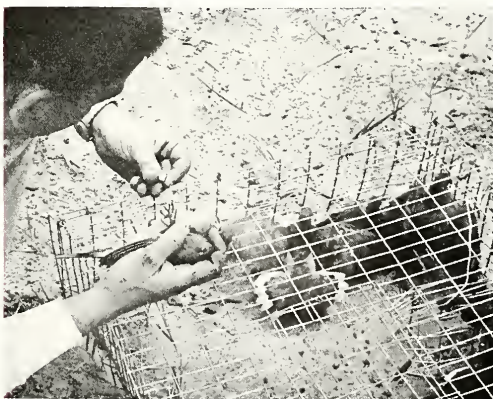
Study Leader

Presently, and for the past two years, the major concern of this study has been the collection of management data useful in establishing annual regulations. Information on population trends and annual production has been obtained during the past two years. This has been done through the use of random road counts which are made in all districts throughout the year, and by the use of annual call counts which are made in May and June of each year.

Random road counts, which have been made dur-



Biologist Bob Beter assembling dove traps for Grand Terre operations with the assistance of "Speedy" Hatchell.



Biologist Bob Beter banding doves at Grand Terre.

ing the past two years, indicate little or no change in the dove population during the two year period.



A few white-winged doves (a close relative of the mourning dove) were also trapped on Grand Terre.

Call counts have also indicated a static population for this period. From available information it seems obvious that the mourning dove population has been at a peak since about 1955. There is no information available to us which indicates any significant increases or decreases in the dove population during this period.

A major effort has been made during the past year toward tabulating and analyzing the backlog of dove banding data which has accumulated during ten years of active trapping and banding. Most of this work has been done under the new joint PR-DJ Project, FW-2R which is under the leadership of Herbert Stern, Jr. It is felt that a publication dealing with these data will be forthcoming within the next biennium.

Only two permanent dove banding stations have been in operation during the past two years: one at Camp Claiborne, near Alexandria, and the other at Selman Field, near Monroe.

Additionally, a major effort has been made in the past two years to band doves at Grand Terre Island and Marsh Island. This operation is conducted annually in October and November in an effort to obtain badly needed information on the origin and destination of this coastal flight of doves. Thus far, approximately 800 doves have been banded at these stations.

It is becoming more obvious each year that much more information is needed on a nationwide basis if we are to manage this important resource in a manner which best suits the needs of the species and the hunting public. It is to be hoped that a realistic approach toward the development of refined techniques for gathering data on population dynamics of this species on a national scale will be taken in the immediate future.

QUAIL INVESTIGATIONS

ROBERT E. MURRY

Study Leader

The present quail study was begun in January of 1954 and has undergone considerable change since that time. Most of the original objectives have been attained. One, the determination of the cost of quail management by burning, was dropped because no land was obtained for this treatment. The cost studies of quail management by disking and planting common lespedeza and by the maintenance of artificial quail feeders have been completed except for the final project report.

A study has been made of available data from management area quail hunts where the total kill is measured and separated as to sex and age.

Cooperating hunters from throughout the state are furnished coin envelopes, data cards, and return postage envelopes with which they save quail wings and record hunt data for the quail study. Since age determination can be made from the characteristics of the wing feathers, a young-old ratio can be determined. This is probably one of the best production measures that can be obtained from a wild, state-wide game population. The data cards serve to measure hunter success, average estimated covey size, crippling loss and the abundance and distribution of woodcock in Louisiana during quail season.

Information gathered from management area hunts serves to illustrate the role of annual production in providing hunting season quail. A limited

season, following years of complete closure, results in a kill with proportionately more adults than are found in an annually shot population. The total population does not seem to be unusually large or small on an area provided protection from the gun; the only apparent difference is the per cent adults in the population.

For the purpose of illustrating the type of information which is thought to provide a valuable year-to-year index, Table No. 1 is included. The information contained in this table was computed from volunteer hunter reports of quail hunts. It may be worthy of note that the average estimated covey size held up well throughout each season.

In Table II the ages of 2199 quail were determined. One wing from each of these birds was sent in by cooperating hunters. Because of the differences previously mentioned the information from management area hunts is not included.

TABLE I
Hunter Success For All Districts
1957-58 And 1958-59 Quail Seasons In Louisiana

Month	Hunts Reported	Number of Hunters	Number of Coveys	Average Covey Size	Total Bagged	Bag Per Hunter	Bag Per Covey	Percent of Total Bagged	Total Crippled	Crippling Percent
Dec., 1957	14	28	73	12.7	234	8.3	3.2	25.3	21	8.8
Jan., 1958	115	209	368	12.0	1112	5.3	3.0	25.1	134	12.0
Feb., 1958	64	107	199	12.0	560	5.2	2.8	23.5	91	16.2
TOTALS 1957-58	193	344	640	12.1	1906	5.5	3.0	24.6	246	12.9
Nov., 1958	33	65	117	13.9	380	5.8	3.2	23.3	59	15.5
Dec., 1958	63	100	185	12.8	515	5.2	2.8	21.8	65	12.6
Jan., 1959	62	113	168	13.1	506	4.5	3.0	22.9	60	11.8
Feb., 1959	21	42	52	14.0	189	4.5	3.6	25.9	23	12.1
TOTALS 1958-59	179	320	522	13.3	1590	5.0	3.0	22.9	207	13.0



"Mr. Bobwhite" looks the situation over.

TABLE II
Age of Quail Bagged During 1958-59 Season in Louisiana

<i>Date</i>	<i>Dist.</i>	<i>Sample Size</i>	<i>Adult</i>	<i>Tot. Imm.</i>	<i>Late Hatch</i>	<i>Percent Immature</i>
Nov., 1958	I	99	25	74	35	74.7
Dec., 1958	I	237	61	176	43	74.3
Jan., 1958	I	192	39	153	14	79.7
Feb., 1958	I	48	7	41	0	85.4
Date Unknown	I	54	14	40	3	74.1
Total Sub-Sample	I	630	146	484	95	76.8
Nov., 1958	II	51	11	40	31	78.4
Dec., 1958	II	174	43	131	29	75.3
Jan., 1959	II	139	35	104	8	74.8
Feb., 1959	II	39	17	22	0	56.4
Total Sub-Sample	II	403	106	297	63	73.7
Nov., 1958	III	89	21	68	31	76.4
Dec., 1958	III	199	48	151	33	75.9
Jan., 1959	III	142	44	98	0	65.8
Feb., 1959	III	55	16	39	0	70.9
Date Unknown	III	470	110	360	50	76.6
Total Sub-Sample	III	955	239	716	114	75.0
Nov., 1958	IV, V, VI, VII & VIII	29	10	18	2	64.3
Dec., 1958	IV, V, VI, VII & VIII	41	15	26	11	63.4
Jan., 1959	IV, V, VI, VII & VIII	68	21	47	1	69.1
Feb., 1959	IV, V, VI, VII & VIII	31	5	26	0	83.9
Total Sub-Sample	IV, V, VI, VII & VIII	168	51	117	14	69.6
Unknown	Origin Unknown	43	11	32	7	74.4
TOTALS		2199	553	1646	293	74.9

RABBIT INVESTIGATIONS

JACK A. SIMS Study Leader

The status of the rabbit has undergone great change in Louisiana in the past few decades. Not much time has elapsed since it was legal to hunt rabbits year round for food.

The rabbit of those days was not worth a great deal since few people took advantage of the lack of restrictive regulations and hunted rabbits.

Today, descendants of those same rabbits are highly prized game animals in some parts of the state. In other areas, the human populace is divided in their opinions about the value of the rabbit. Some people see him as only a marauder of winter gardens, while others picture him as a noble game animal leading a pack of bawling beagles on a merry chase.

In areas of Louisiana with the greatest concentrations of people and the least in the way of hunting opportunities for other game, the sport of rabbit hunting has enjoyed a tremendous increase. The popularity of rabbit hunting with beagles has moved well up towards the front as a sport of Louisiana hunters.

The first steps toward rabbit management came in the form of restrictive legislation. The setting of seasons, bag limits, and restrictions against night hunting, etc., were designed to assure a breeding stock of rabbits and to make an equitable distribution of hunter kill. While restrictions definitely have a place in management, these failed to restore rabbits to their former abundance on areas where unfavorable habitat changes had occurred.

Since technical game management was already well established before we in Louisiana felt any need or heard any demand for rabbit management, we were able to successfully resist the demands to provide more rabbits by restocking. To do this, information was drawn from research results published in other states and from accounts of management failures encountered with rabbit stocking programs. We were also aware of the lack of success of ventures in other states which were aimed at making more rabbits for the hunter by closing areas to rabbit hunting.

We had at our disposal, a fair general knowledge of essential life history information, especially of the cottontail. Less was known of the more important swamp rabbit and we needed more local information on breeding dates, litter size and habitat requirements of both species.



The start of a new crop.

Earlier research prior to the present biennium has provided us much basic knowledge. During the past two years, rabbit research has had three general aims.

1. The measurement of trends in population changes by employment of the random road count. To effectively do this, each P-R employee records his daylight travel mileage and the number of rabbits seen along the highways, both dead and alive. This is expressed as rabbits per hundred miles by district and by month.

While weather, traffic, rabbit density, and mating activity are known to affect the number of rabbits seen, this is none-the-less, believed to be our best method of detecting population changes.

2. A hunter questionnaire is used to solicit reports of each hunt from a number of cooperating hunters. These hunters submit the data at the end of the rabbit season. While these hunters are not claimed to be representative of all the rabbit hunters, it is believed that any marked change in their hunting success will indicate a statewide change.
3. An attempt has been made to measure the effects of cattle grazing on a rabbit population of a woodland pasture. This study has employed the use of line traps and ear tags. It is located on two 40 acre study areas in Morehouse Parish, one grazed, the other free of cattle. Over 100 rabbits have been captured, marked and released on the study areas. Many of these have been recaptured, one "trap-happy" individual, a total of 54 times.

Since trap success may not accurately indicate the effect cattle have had on rabbit numbers, some census method of known accuracy is needed for these areas. The rabbit trapping and marking study has, however, provided some good information regarding the home range, cruising radius, population turnover, and per cent young of both cottontails and swamp rabbits. The trapping operation has been the most successful from the standpoint of number of swamp rabbits marked of any trapping in the country.

For the future it seems that the greatest need

is to learn the cheapest and most effective technique for managing large bottomland farms for better rabbit production. There has been considerable alarm expressed by landowners regarding the scarcity of rabbits on larger farms; especially where cane, rice, or cattle comprise the main crop.

Since most of our hunters favor the swamp rabbit, and there has been such a small amount of research directed at this species by game departments of other states, we need to devote much of our efforts to it. We can largely rely upon the published findings of others for pretty good cottontail management information, but we had better expect to find most of our swamp rabbit answers here at home.

SQUIRREL INVESTIGATIONS

J. B. KIDD
Study Leader

Trapping, Tagging and Tag Returns

One of the more important phases of squirrel research being conducted is the trapping and tagging operation which is carried out annually on the Grant-Rapides game management area. The purpose



Squirrel in typical pose.

of this study is to determine the effects of hunting on populations and also to estimate total populations on the area involved. Since this trapping and tagging operation was initiated in 1957 and the results of each year are interrelated, it has been decided to present the information for all three years involved—1957-58-59.

1957 Analysis

During the four month period prior to the opening of the squirrel season on October 18 in 1957, a total of 97 squirrels were tagged. During the 15 day season, in which 2445 squirrels were killed, 14 tagged squirrels were returned by hunters.

The 14 tagged squirrels returned by hunters represent a 14.4 per cent return of the tagged squirrels. Assuming that the hunters killed the marked animals in the same proportion as the unmarked animals, this figure indicates that 14.4 per cent of the population was harvested. The total population before hunting may then be calculated by the following equation:

$$\frac{97 \text{ (Total tagged animals)}}{14 \text{ (Tag returns by hunters)}} = \frac{X \text{ (Total population)}}{2445 \text{ (Hunter Kill)}} = \frac{16940 \text{ Total estimated population before hunting}}{7717 \text{ Total estimated population before hunting}}$$

During the 1958 trapping and hunting season 19 retraps occurred from squirrels which were tagged in 1957. There were also 6 one year old returns by hunters. Three of these had been retrapped and three had not. In 1959 four more of the 1957 squirrels were located—2 were killed and 2 were retrapped.

In reviewing the above figures the following is noted: (1) fourteen of the tagged animals in 1957 were killed immediately after hunting began during the same year; (2) six were killed one year later; (3) and 2 were killed two years later.

Retrapping revealed that 19 were retrapped one year later (3 of which were killed) and 2 more retrapped two years later. It has been further determined that of the 83 possibles after the 1957 hunting season, 26 survived to the following year (32 per cent). Two years later 4 more of the 1957 tagged animals were accounted for. This represents a known survival rate to the second year of 5 per cent and is determined in the following manner: $97 \text{ (Total tagged in 1957)} - 14 \text{ (killed by hunters in 1957)} = 83 \text{ possibles left}$; $83 - 6 \text{ (killed by hunters in 1958)} = 77 \text{ possibles left}$; $4 \text{ (2 killed, 2 retrapped in 1959)} \div 77 = 5 \text{ per cent}$.

One further calculation revealed that there was a minimum of 40 animals alive and tagged of the 97 trapped in 1957 when the season opened that fall. This has been determined by the following summation: $14 \text{ (killed by hunters in 1957)} + 16 \text{ (retraps in 1958)} + 6 \text{ (killed by hunters in 1958)} + 2 \text{ (killed by hunters in 1959)} + 2 \text{ (retrapped in 1959)} = 40 \text{ (known to be alive and tagged)}$.

1958 Analysis

In 1958 the same trapping procedure was followed which resulted in the tagging of 102 new squirrels. Hunters during a 10 day season killed 14 tagged animals which represents a 13.7 per cent return. During the 1959 trapping and hunting season 14 of the 1958 squirrels were retrapped and 4 were killed, 2 of which were retrapped. This represents a known survival rate to the following year of 18 per cent.

The total population of the area before hunting

may then be estimated by the same calculation as before:

$$\frac{102 \text{ (Total tagged animals)}}{14 \text{ (Tag returns by hunters)}} = \frac{X \text{ (Total population)}}{1059 \text{ (Hunter kill)}} = \frac{7717 \text{ Total estimated population before hunting}}{1059 \text{ (Hunter kill)}}$$

1959 Analysis

The trapping technique was changed this year. In 1957 and 1958 all the trapping was done along jeep trails. It was thought that perhaps the tag return may have been lower if the trapping was done on a random basis, since the hunters seemed to hunt along jeep trails more heavily than other sections of the woods. With this in mind the area was divided in half. One section was trapped in the same manner as has been done in the past. On the other section grid lines were projected at right angles to each other. Where these lines intersected a trap site was located. In this manner this section of the area was trapped on a purely random basis.

During the trapping period 105 squirrels were tagged off the area where random trapping was done and 100 animals marked along the jeep roads. During the hunting season 19 tags were returned from the random area as compared to 14 from the other.

This represents an 18 per cent return from the random trapped area as compared to a 14 per cent return off the area where trapping was done on the jeep trails. Combined, these figures show a 16 per cent return from the tagged animals of 1959.

From the tag returns above it would appear the hunters during the past season dispersed and hunted the random area with the same intensity as they hunted along the jeep roads. This would tend to point out that trapping along the jeep trails and the returns from such trapping and tagging is just as valid and accurate a method in measuring hunter kill as the information revealed when the trapping was done on a random basis. The two methods will again be used in 1960 and the results studied.

As was done for the previous years the estimated 1959 population has been calculated by the following:

$$\frac{205 \text{ (Total tagged)}}{33 \text{ (Total returns)}} = \frac{X \text{ (Total population)}}{1899 \text{ (Killed by hunters)}} = \frac{11797 \text{ Total estimated population}}{1899 \text{ (Killed by hunters)}}$$

It is interesting to point out that there is very close resemblance in the per cent of tag returns between the three years involved. In 1957 the tag return was 14.4 per cent, in 1958, 13.7 and in 1959, 16.0 per cent return. If the tag returns are valid in measuring hunter kill, this would show that approximately the same per cent of the total population has been killed each year.

Before closing it should be pointed out that no correction has been made for natural mortality or tag loss in the calculations used. Natural mortality between tagging and the first hunting season is thought to be negligible.

This is substantiated by the fact that each summer more marked squirrels, that have survived at least one hunting season, are retrapped, than the hunters were able to kill the previous season. A

combination of toe clipping and ear tagging to be used this coming year should eliminate all speculation about ear tag losses.

Hunter Bag Checks

During the 1959 season 8 game management areas were opened to squirrel hunting for varying lengths of seasons from three to fourteen days. The areas involved, which are listed in Table I, include some 145,000 acres. There was a total of 5,972 hunts made on these areas which resulted in the killing of 12,355 squirrels. The average hunter-success was 2 squirrels per hunting effort. This hunting success average was much better than the 1958 season. Data from five comparable areas opened in 1958 revealed an average kill per hunting effort of 1.6 squirrels. The total number of hunts made on these areas was 4,743 which netted a total of 7,956 squirrels killed.

Hunting success in 1959 on the game management areas was the best the hunters experienced since 1955. It is noted from Table I that on five areas where comparison could be made, the average hunter success was greater in each case in 1959 than in 1958. This increase in hunter success was expected as the mast conditions of 1958 were favorable for good breeding success and a higher population in the fall of 1959. The mast conditions of 1959 were again good. This should mean even better hunting success in the fall of 1960.

Although the bag limit was reduced from 8 squirrels in 1958 to 6 in 1959, there is no evidence that this reduction in the bag limit had anything to do with limiting total kill.

As can be seen from Table I hunter-success was much greater in 1959 than 1958, and on 4 areas out of 5, where comparisons are made, the total kill increased. In one area, Jackson-Bienville, the total kill increased more than 50 per cent.

It should be further pointed out that the increase in the squirrel population occurred with a bag limit of 8 in force. All breeding and production was over when the bag limit of 6 went into effect in 1959.

It has been maintained in the past, that Louisiana's bag limit on squirrels should be no less than

8 squirrels per day. Although there are actually very few hunters on a state-wide basis who are able to kill a limit of 8 squirrels, there is no biological reason to deny them this opportunity if it should occur.

Breeding Studies

Information collected on breeding is presented in Tables II and III. It is noted that the percentage of juveniles was larger in 1959 than 1958. This is to be expected in expanding populations where production is good. The percentage of summer born gray squirrels in 1959 was the highest seen since this study has been initiated. Forty-two per cent of the hunter-kill was made up of summer born animals.

There is a noted preponderance of females in the 1959 figures. Some research workers have noticed that females out number males in expanding populations. Whether this is a true factor or not in Louisiana is not proven yet, but the 1959 data indicates this may be the tendency.

TABLE I
Squirrel Hunter Bag Checks
1958 & 1959

Year	Area	No. Hunts Made	Squirrels Killed	Average Kill Per Hunting Effort
1958	Evangeline	179	135	.75
1959	Evangeline	176	207	1.10
1958	Union	178	343	1.92
1959	Union	279	667	2.39
1958	Grant-Rapides	757	1059	1.39
1959	Grant-Rapides	1020	1901	1.86
1958	Jackson-Bienville	869	830	.96
1959	Jackson-Bienville	1520	2145	1.74
1958	Thistlethwaite	2860	5589	1.95
1959	Thistlethwaite	2125	5195	2.45
1958	Catahoula Not Opened This Year			
1959	Catahoula	438	1105	250
1958	Chicago--Mills Opened But No Permits Required			
1959	Chicago--Mills	245	715	2.91
1958	Caldwell Not Opened This Year			
1959	Caldwell	169	420	2.48

All hunters required to secure permits each day unless otherwise specified.

TABLE II
Age and Sex Ratios and Breeding Conditions of Females
1958

	Total No. Males & Females		Total No. Adult Females		Total No. Adult & Juvenile Females		Total No. Juvenile Females		Ages of Females Unknown
	Males	Females	Breeding	Non-Breeding	Adult	Juveniles	Spring Born	Summer Born	
PERCENT	49.8	50.2	11.4	88.6	79.4	20.6	65.6	34.4	0
GRAY			11 suck.						
NUMBER	154	155	3	109	123	32	21	11	0
PERCENT	49.0	51.0	27.9	72.1	52.3	47.7	87.3	12.7	0
FOX			40 suck.						
NUMBER	270	281	1	106	147	134	117	17	0

The above data computed from bag checks made on Thistlethwaite, Grant-Rapides and Union game management areas.

TABLE III

Age and Sex Ratios and Breeding Conditions of Females

1959

	<i>Total No. Males & Females</i>		<i>Total No. Adult Females</i>		<i>Total No. Adult & Juvenile Females</i>		<i>Total No. Juvenile Females</i>		<i>Unknown Ages of Females</i>
	<i>Males</i>	<i>Females</i>	<i>Breeding</i>	<i>Non-Breeding</i>	<i>Adult</i>	<i>Juveniles</i>	<i>Spring Born</i>	<i>Summer Born</i>	
PRECENT	47.0	53.0	10.0	90.0	50.0	50.0	57.6	42.4	....
GRAY			169 suck.						
NUMBER	3429	3868	25	preg. 1737	1931	1928	1110	818	9
PERCENT	46.2	53.8	13.6	86.4	45.9	54.1	73.8	26.2	....
FOX			91 suck.						
NUMBER	1477	1722	12	preg. 655	758	890	657	233	74

The above data computed from bag checks made on Chicago-Mills, Jackson-Bienville, Thistlewaite, Grant-Rapides, Union, Catahoula, and Caldwell game management areas.

OAK MAST AND T.S.I. INVESTIGATIONS

JACK O. COLLINS

Study Leader

In July of 1950 the oak mast research project was initiated. Originally, trees were selected for study on two areas. One was on the Red Dirt Game Management Area in Natchitoches Parish; the other was on the Catahoula Game Management Area in Winn and Grant Parishes. Both are on lands of the Kisatchie National Forest. In 1955 the project was expanded to gather information on trees located in the parishes of Bienville, Union, Concordia, Allen, St. Landry, and Iberville. For the past two years

Objectives of the investigation are: (1) to determine mast yields and any cyclic production characteristics that the oaks may have, and (2) to correlate mast production with tree crown size, bole diameters, age, tree stand densities, and timber management practices.

To most sportsmen, foresters, wildlife technicians, and other interested groups it has been apparent for a number of years why information on the above objectives is needed.

The fact that acorns are one of the most important wildlife foods in Louisiana is recognized by almost everyone. Deer, squirrels, quail, turkeys, wa-



Study Leader Jack Collins measuring tree.

data has been collected from Morehouse Parish.

Most commonly occurring oaks were selected for study. Trees in the red oak group which are being studied are blackjack oak, water oak, willow oak, sandjack oak, southern red oak, nuttall oak, and obtusa oak. Those in the white oak category include post oak, cow oak, white oak, and overcup oak. White oaks require one growing season to mature acorns; red oaks require two seasons.



Biological Aide, Charles R. "Chili" Baur removing acorns from acorn trap.

terfowl, hogs, many kinds of birds, coons, flying squirrels, and rodents, such as rats and mice, are some of the better known animals that eat acorns. For some of these animals such as the gray and fox squirrel acorns are an essential part of the diet; for others such as deer, acorns serve as an important supplement in their diet. Although deer prefer acorns to just about any other type food, deer herds cannot be managed on acorn supply, but must be managed on the basis of available deer browse. Even during bumper mast crop years such as 1958 and

1959 acorns are available for only about four months out of the year.

In the upland sections of Louisiana the timber interests have rapidly increased their rate of managing the pine forests for more and better yields of the various products such as pulpwood, poles, piling, and sawtimber. In managing a forest one of the first steps taken is to remove undesirable hardwoods from the stand. This is commonly called Timber Stand Improvement (T.S.I.). Economic demands are the motivating factor back of most T.S.I. operations. Timber Stand Improvement is often necessary for the landowner or pine tree grower to break even or make a dollar. In many instances



Study Leader Jack Collins recording weight of acorns.

removing undesirable hardwoods from a stand not only benefits forest interests but also improves the wildlife habitat. It is especially true when a sufficient number of oaks plus understory vegetation is left in the stand.

Not only the wildlife technicians, but also many foresters and landowners are keenly interested in leaving some oaks and understory plants in their timber stands for the primary purpose of benefiting wildlife. Frequently, the question is asked, "how many oaks should I leave in my stand?" This can be partly answered by asking two questions (1) how much can he afford to let hardwoods and understory vegetation compete with his pine stand and (2) to what degree does he want to benefit wildlife.

The method of operation for the oak mast phase of the project was discussed in preceding biennial reports.

Briefly outlined below are some important facts that have been gathered from the study, thus far.

1. Bottomland species (water oak, willow oak, nuttall oak, overcup oak, cow oak, and white oak) produce more acorns than upland species (post oak, blackjack oak, sandjack oak, and southern red oak).
2. Regardless of the species, a tree shows consistency in its manner of production; that is, if results are high one year the same trend will continue on productive years.
3. Acorns vary considerably in size. Individual trees of a species produce small acorns while

others produce acorns two or three times as large. The significance of this is apparent. A tree yielding few, but large acorns may bear as many pounds of nuts as one yielding more but smaller acorns.

4. Substantial acorn yields cannot be expected below the age of 25 years on the oaks being studied in Louisiana. Many factors affect this. One is competition. Trees in crowded stands produce at a later age than those found in open growing conditions.
5. Even during bumper crop years for any species all trees of mast bearing size and age do not produce. In the better years only about 60 per cent of the white oaks bear and about 90 per cent of trees in the red oak category yield fruit.
6. Oaks are cyclic in their productive characteristics. No species can be expected to produce a crop of acorns every year. Many factors influence yields. Perhaps, the most important one is weather. A good example is the late spring freeze that commonly occurs in Louisiana. When this happens during the flowering season of the oaks, production fails on the affected white oaks the same year and on red oaks the following year. This is one reason why it is good to leave a variety of oaks in the stand where regularity in acorn crops is desired.
7. Best acorn crops come from healthy, vigorous growing trees with well-developed crowns and larger diameters.

Since the inception of this project a mass of data has been gathered, but the information to follow covers the period of 1957 and 1958.

On all areas of study in Louisiana except one, West Bay Game Management Area in Allen Parish, during 1958 a bumper mast crop, was produced by trees in the red oak classification. Yields were only moderate in 1957.

Yields from trees in the white oak category were only moderate in 1958. However, production figures indicated an increase over 1957.

Some average yields and weights of oak mast from various sections of the state are presented herein. This data includes the years 1957 and 1958. On the Jackson-Bienville Game Management Area, water oaks bore 8448 acorns (20.07 pounds), willow oaks—4,851 acorns (12.44 pounds), post oak—0 acorns, white oak—410 acorns, and southern red oak—1,568 acorns (2.72 pounds). In Union Parish southern red oaks produced 1,297 acorns (2.05 pounds), white oak—81 acorns, cow oak—31 acorns (0.27 pounds), post oak—108 acorns (0.136 pounds), water oak—2,310 acorns (6.50 pounds), overcup oak—190 acorns (0.67 pounds). In Morehouse Parish willow oaks bore 14,388 acorns (28.88 pounds), overcup oak—236 acorns (1.49 pounds), and post oak—632 acorns (1.02 pounds).

On the Red Dirt Game Management Area, blackjack oaks bore 1,051 acorns (2.57 pounds), sandjack oak—217 acorns (0.298 pounds), water oak—2,460 acorns (6.38 pounds), white oak—426 acorns (2.66 pounds), southern red oak—957 acorns (1.45

pounds), cow oak—255 acorns (2.15 pounds), and post oak—0 acorns. In St. Landry Parish on the Thistlewaite Game Management Area willow oaks yielded 6,645 acorns (13.48 pounds), nuttall oak—1,469 acorns (8.29 pounds), and overcup oak—2,256 acorns (3.36 pounds). In Iberville Parish overcup oaks bore 93 acorns (0.69 pounds), water oak—968 acorns (1.86 pounds), and nuttall oak—4,158 acorns (22.43 pounds).

Acorns are subject to heavy damage by weevils. Over the entire state, the percentage of sound acorns was high in 1958. This was in direct contrast with the previous year when a heavy weevil infestation resulted in an abnormally low percentage of sound acorns. From Red Dirt, it has been determined that over the nine-year period about 25 per cent of all acorns reaching maturity are unsound.

The Timber Stand Improvement Study

In conjunction with the oak mast study the Timber Stand Improvement (T.S.I.) project with relationships to its effects on wildlife was begun in 1954. The study plots are located on the Catahoula Game Management Area which is about 30 miles north of Alexandria in the parishes of Winn and Grant. Purposes and objectives of the study were discussed in previous biennials.

Originally, various jobs were outlined to determine effects on wildlife and wildlife habitat by four types of T.S.I. treatment. These types are as follows: (1) U. S. Forest Service method, (2) Compromise cut recognizing minimum wildlife requirements, (3) Clearcut (all hardwoods removed), and (4) Control (uncut). Plots treated for study are 160 acres in size. There are two of each type.

More specifically, aims of this study are to find out some of the effects of the above T.S.I. methods on squirrels, deer, and oak mast.

Facts relating to the study that will be presented below cover the period from July, 1957 to June, 1959.

Concerning the acorn mast phase sixty trees are under study on the six 20 acre plots treated according to the methods outlined above. For apparent reasons no mast studies were conducted on the two clearcut plots. Over the three year period, 1955-1958, five southern red oaks and five post oaks were studied on each plot. This was for the purpose of gathering yield data and related information. All trees exhibit either dominant or codominant crowns. It was pointed out previously that the two species were selected because they comprise the major portion of the oaks in the stand.

As pointed out in the oak mast phase of this project, many factors affect acorn yields. Over the first three years of checking, acorn crops were low on most all the study trees. Hence, no comparisons between results on different type treatments will be made in this report. Preliminary checks show the 1959 acorn crop to be much higher than on any of the previous years. More detailed data will be available for the next report.

Almost everyone knows acorns are essential food in the diet of squirrels. In fact it is generally believed by most wildlife technicians and others that squirrel populations fluctuate on the basis of avail-

able acorn supply from one year to another. Thus, to determine the effects of various T.S.I. treatments on squirrel populations, a squirrel census was conducted on each of the eight areas each month. This was terminated in the spring of 1959. Although analysis of data has not been completed it should be noted that those areas having less oaks in the stand showed a smaller squirrel population.

Deer browse investigations relating to T.S.I. operations revealed some interesting facts to be discussed in the following paragraphs.

Deer browse surveys using the Aldous method were conducted on each of the eight Timber Stand Improvement study plots in 1958 and 1959 as in the two previous years. Twenty mil-acre plots were checked on each of the twenty acre study areas marked off for intensive investigations. For purposes of analysis the browse surveys on the two areas having like treatments were combined.

On the "U.S. Forest Service treatment" twenty-three species of plants were browsed in 1959. Twenty-seven of the 33 species listed for study were present on one or more of the 40 plots sampled. 23, 25, and 24 species were browsed in 1956, 1957, and 1958, respectively.

There was no browse on red oak or white oak sprouts in 1959. Red oak sprouts were mainly Southern Red oak; white oak sprouts consisted primarily of the Post oak. This was the fourth year of browse sampling. On red oak sprouts browsing was moderate the first year after T.S.I., light the second year, and entirely absent or very low the third year after treatment. On white oak sprouts a fair degree of browsing occurred in 1956, 1957, and 1958.

The danger zone of overbrowse known as index of browse, was lower on a number of species in 1959 than in 1958. This can partly be attributed to a better growing season in 1958 than in 1957.

The method referred to here as "Compromise Cut Recognizing Minimum Wildlife Requirements" showed from the deer browse surveys that seventeen species of plants were browsed in 1959. Of the 33 species listed for study 21 were present on the plots. In 1957 and 1958, 20 and 25 species, respectively, were present, 24 of 24 species were browsed in 1958.

In 1959 there was no browsing on red oak sprouts and an insignificant amount on white oak sprouts.

The number of plants in 1959 that had an index of 100 or more decreased from that of 1958. In 1959, the number of species in this category was four; it was eight in 1958.

On the "Clearcut treatment" the browse survey showed 19 of the 33 plant species were present on one or more of the 40 plots examined in 1959. 15 of the 19 showed usage, although frequently in minor amounts.

Sprouts from red oaks and/or white oaks exhibited no usage in 1959. Usage was minor in 1958.

Plant composition on the clearcut plots varied considerably from that on the controls in 1959 as in 1958. From the standpoint of deer food value, less desirable plants were most common in occurrence. Most frequently occurring species were red oak sprouts, blackberry, greenbrier, hawthorn, spring huckleberry, pine, St. Andrew's Cross, and sweet-gum.

Browse surveys on the "Control" or check plots showed 26 of 33 species were present on the plots in 1959. Twenty-three of the 26 were browsed in varying amounts. More uniformity in plant composition existed on the control plots.

With the continuation of parts of this project for some time to come, it is hoped that a better understanding of oak mast and T.S.I. with their implications on wildlife will be attained.

RESEARCH DESIGN, MACHINE COMPILATION AND ANALYSIS OF DATA PROJECT FW-2R

HERBERT STERN, JR.
Project Leader

Because of the following reasons: (1) An ever increasing work load; (2) A need for more rapid and accurate manipulation of research data; and (3) The necessity for statistically valid procedural design and interpretation of results—it has become necessary to include in the research system of fish and wildlife a project to help plan, coordinate, and advise on research design and analysis, and to plan and supervise machine tabulation of research data.

This cooperative Pitman-Robertson and Dingell-Johnson Project was inaugurated July 1, 1959, and in the period covered by this biennium the following work was begun:

1. A design to place all bird banding records on punch cards for machine processing of data.
2. The machine processing of creel census data for Dingell-Johnson Projects F-1R and F-7R.

Cooperative Statistical Project

In addition to the above two jobs, Project FW-2R is serving as the coordination in Louisiana to the Southeastern Cooperative Statistical Project.

This cooperative endeavor has been organized by certain states of the Southeast in the interest of improving our management of fish and wildlife resources. We propose to accomplish this by cooperating with the North Carolina State College Institute of Statistics and with each state sharing in the costs of the program.

Improved management of fish and wildlife resources rests on research investigations which shed more light on the habits, requirements, and dynamics of fish and game populations. Statistics can play a large part in such a process in that research programs must be designed so that the results obtained are both worthwhile and susceptible to mathematical evaluation to determine their reliability for application as game and fish management tools.

STATEWIDE WILDLIFE DEVELOPMENT AND OPERATIONS PROJECT W-30D

KENNETH C. SMITH
Project Leader

It has become rather evident to the people responsible for managing game animal populations that the last word has not yet been written on the

subject. Several points have been brought into strong focus during the last two years that in the past were only remote possibilities for the future and therefore were pushed back in the minds of game managers who had more pressing matters to be attended to then.

One of these is the tremendous response by the public to "public shooting areas" on which fair to good game populations existed and which were open to anyone who wished to make a hunt. Some of these areas have been open to squirrel hunting since 1954, and some even had shootable deer populations at that time; but could not be opened for deer hunting because of public opposition. When the first "buck only" deer hunts were initiated on Red Dirt in 1955 and Catahoula Game Management Area in 1957, the response was not spectacular. The 1955 Red Dirt hunt attracted approximately 2,000 hunters, who took a total of 90 bucks in 5 days and the 1957 Catahoula hunt drew 1,301 hunters, who killed 26 bucks. By contrast, the 1959 Red Dirt hunt, five days "bucks only" and one day "any deer" attracted 5,500 hunters, who removed 327 animals, and the Catahoula hunt of the same year and same number of days, saw 6,399 hunters take 354 deer. These are not the only examples which point up an ever increasing need for public shooting areas. Another noteworthy case is the 1959 Jackson-Bienville hunt on which 3,000 people made a hunt on the first day of the 5 day or 350 deer season and took 280 deer that day alone. The response was so great this area was closed at the end of the second day's hunt.

Along with an increasing number of hunters has come another aspect of hunting on game management areas which until the 1959 season has been of no great concern—that of too much gunning pressure on game populations. Up to and including the 1958 season, the problem was in placing enough pressure on game populations, particularly deer, to remove a sufficient number of animals to prevent over-crowding. Everything was planned for the 1959 season in such a manner that would encourage this needed gun pressure. Any deer were legal from one-half day to three days on six of the areas, yet there remained some doubt in the minds of the game managers that even this would have the desired effect. Had the response been comparable to that in the past the Commission would still be seeking means to take more deer, but here is where many people were surprised. Hunters turned out in large numbers and five of the six areas opened to "any deer" saw a larger kill than had ever occurred on similar acreages in Louisiana. Interested persons expressed concern that the kill was too great and therefore would cause the herds to suffer. This opinion was not shared by any of the biologists on whose shoulders rests the responsibility of making recommendations of this nature to the Commission. One very important point did present itself—the possibility of removing too many animals by "still hunting" where there is no control on the number of hunters. Some manner of control will very likely be placed on these areas in the near future unless

sufficient additional acreage is made available.

All the above figures are available in the current and preceding biennial reports, but it was felt that by holding them up side by side the reader could get a better picture of the increased demands being made on existing areas. It should also be kept in mind that this large number of hunting efforts occurred on rather small acreages. The game management areas are 8,500 to 40,000 acres in size and at present there are only twelve in the state which have shootable deer populations. These twelve were established with Pittman-Robertson funds and personnel. The discouraging fact here is that P-R funds are not increasing so consequently the program cannot be expanded to meet the ever increasing need for more shooting area development. Additional funds must be forthcoming if the Louisiana Wild Life & Fisheries Commission is to fulfill its obligation to the public.

DISTRICT I

JOHN L. HAYGOOD
District Game Supervisor

ROBERT B. KIMBLE
Game Biologist

District I game work is varied, most of it has already been included in the reports of the research study leaders. The personnel of this district help collect this information plus carrying out all of the development work, answering inquiries, complaints, etc. Assisting other public agencies in wildlife work such as management plans and recommendations for public lakes and public lands is a part of their duties. All kinds of inquiries, from how to get rid of armadillos to how to raise more game on the



Biologist checking wood duck box on Lake Bistineau.

from female White-Tail Deer we can learn several farm, come into the district office. There are three game management areas in this district, two active and one inactive. These are leased to the Wild Life and Fisheries Commission for wildlife development and management. The reports on these are as follows:

BODCAU GAME MANAGEMENT AREA

KINSEY MARTIN
Area Supervisor

This is the most comprehensive management area in the state. Within its boundaries there is suitable habitat for every species of game animal found in Louisiana, excluding geese. The Bodcau G. M. A. is located on the U. S. Army Corps of Engineers'



Acting chief, Fish & Game Division, Ted. B. Ford, P-R coordinator, John D. Newsom and district game supervisor, John Haygood, examining chufa crop in Bodcau Game Management Area.

Bodcau Flood Control Project. Through a cooperative agreement the Corps of Engineers gave the Louisiana Wild Life and Fisheries Commission a license to develop and manage the wildlife of this area. The boundaries include all government owned land lying on both sides of Bodcau Bayou from the Arkansas state line to Bellevue in Bossier and Webster Parishes, approximately 37,000 acres.

The topography varies from low cypress swamps to high well drained hills. Between these two extremes there are several different types of forest cover. Probably one of the most important is the oak flats which furnish food and cover for squirrels, deer and ducks. Old fields scattered through the hills are another type of vegetative cover that provide food and cover for upland game such as quail and doves. The soil types are as variable as the vegetative cover. There are variations all the way from swamp muck to red river uplifts to deep sands with hard pan clay soils in between.

The purpose of this management area is to pro-

vide public outdoor recreation in the form of hunting, fishing and camping. It is the object of the Louisiana Wild Life and Fisheries Commission in cooperation with the U. S. Army Corps of Engineers to develop the wildlife resources to their maximum for public use. There are three general types of development work being carried out on Bodcau now.

1. Providing access to the general public is one of the most important phases of development. A road has been completed this year that will allow hunters to drive within easy walking distance of the best hunting areas. From this road one can hunt rabbits, doves, quail, squirrels, and ducks. This road was surfaced with native gravel and washed gravel in the places where it was needed; concrete culverts were installed at all low points. The road is located so that it provides public access, yet disturbance to wildlife populations will be kept to a minimum.
2. Habitat improvement is the second type work being carried out on this area. The most important part of habitat improvement is the mapping and cataloging of all vegetative cover within the Bodcau G. M. A. When this work is completed a long range planning program will be initiated. Then each acre will be managed to provide maximum benefits for wildlife. Work has already started toward thinning undesirable trees and planting beneficial ones. Water and willow oak acorns were collected and planted last winter. There are six fenced and planted plots totaling 172 acres. Free ranging cattle and hogs make it necessary to fence with net and barbed wire any food plantings in this area. Two of the food plots (80 acres) are planted and flooded for ducks. Brown top millet and chufa were planted this past season. The other four food plots (92 acres) are planted for doves, quail and turkeys. There are no turkeys on the area at present but it is hoped some will be stocked this spring. Buckwheat, browntop millet, milo maize, chufa and wheat were planted in these

plots. Some experimental work was tried this year propagating wild food plants. Some 150 acres of old fields were disced to aid the growth of native quail and dove foods. Discing breaks up the grass sod promoting growth of quail foods and making the seed available. Doves must have bare ground available to feed and travel about—heavy grass sods make feeding and travel difficult.

3. Water level control, which floods hardwood bottoms during fall and winter, is the third type of work carried on at Bodcau. By a system of dams, terraces and water gates, water is backed up over oak flats during the winter period for waterfowl. These impoundments are managed as green tree reservoirs. The water is taken off prior to the growing season, thus there is plenty of water and acorns for ducks during the winter but the area is dry enough in summer for the oaks to grow and produce. This past summer another water control structure was added to the main dam. Water levels can now be controlled even during flash floods that might damage timber during the growing season. One mile of terraces was added creating what is called reservoir five. Two water control structures were installed in this terrace. Water from the spillway of the large dam is diverted by canal into this reservoir flooding some 300 acres of the best oak flats in North Louisiana. Fishing has been greatly benefited by these water control structures. During the winter and spring of 1958-59 the bass catch at one water control structure was exceptionally good.

Development at Bodcau is just beginning, the potential is tremendous. The deer herd is increasing rapidly; duck, quail, and dove hunting can be increased ten fold. The habitat is suitable for wild turkeys; all that is needed is a seed stock to work with and cooperation from sportsmen. Since there is no cutting of beneficial hardwoods, squirrel hunting will increase with the growth of hardwood timber. Up to this time all fishing benefits have been accidental. When a planned program of fisheries management goes into effect, fishing success should increase.



Dike for waterfowl area on Bodcau.



End of successful hunt on Bodcau waterfowl area.

JACKSON - BIENVILLE GAME MANAGEMENT AREA

FLOYD Sizemore
Area Supervisor

The Jackson-Bienville Game Management Area is located in the eastern part of Bienville Parish and the northwestern part of Jackson Parish, just south of Ruston and north of Jonesboro. For the last two years this area has been paying dividends on sportsmen's money spent on establishing and developing a huntable deer herd. A total of 425 deer



Scene from Jackson-Bienville game management area showing deer browse on honeysuckle. Bodcau supervisor, Kinsey D. Martin, showing shed deer antlers picked up at this location. were killed on this area during the two years covered by this report. In 1951 the Louisiana Wild

Life and Fisheries Commission leased the wildlife rights to this 22,000 acres. Immediately thirty-seven doe deer were released to add to the small herd already present. Under the care of the Area Supervisor this herd probably reached the ideal carrying capacity of the land in 1957. Due to public opposition, the deer hunting season was not opened until the 1958-59 season. That year the hunt was limited to bucks only. A total of 100 bucks were killed in two short hunts. Browse surveys following this hunting season showed that more deer needed to be removed. The best deer food plants were being eaten completely up. Plants that should carry deer through late winter and spring were being eaten back so far in the fall that only low preference foods were left. Without high quality foods in late winter and spring fawn production drops off, young deer don't get their full growth, and the antler growth declines. On an over browsed range young deer suffer most; they can't reach as high for food as larger deer. On November 26, 1959, this area was opened to "any deer" season, one to five days or 350 deer. The hunt ran for two days; by the end of the second day 325 deer had been killed. Every deer was checked, weighed and aged and antlers measured on bucks. All deer killed were in good shape as far as body fat was concerned; the current year's good acorn crop was responsible for that. The one and one-half year old age class deer were under size; antler formation was poor. These point out the fact of over browsing the past year and a half. Hunters should be able to harvest 300 deer per year from now on. Constant checks on available deer browse will show whether the deer kill should be increased or decreased.

The annual squirrel hunt, the first two weeks of the season, continued as in the past. Next year this



Scene of Jackson-Bienville game management area showing deer browse line on trees.



Buck deer killed by Otis Hampton of Natchitoches, Louisiana 1959 season—Jackson-Bienville Game Management Area.

will probably be cut to one week to reduce cost of operation.

Bow and arrow hunters have had special deer hunts on this area for the past two years. On the first hunt in November 1958, 283 hunts were made with three deer killed. In 1959, 727 hunts were made with only one deer killed. Bow hunting is a good clean sport that is fast increasing in popularity. There was no evidence of a high crippling loss from arrows as rumors have reported.

Maintenance work has been carried on as in the past. Trying to keep the woods roads passable was the most important part of this maintenance. Some bridges had to be rebuilt or redecked. Culverts were installed in places where they were most needed. These roads were graded and worked as much as could be with a Ford tractor. Boundaries were repainted and signs renewed as needed.

DISTRICT II

JOE L. HERRING
District Game Supervisor

CHARLES R. BAUR
Biological Aide

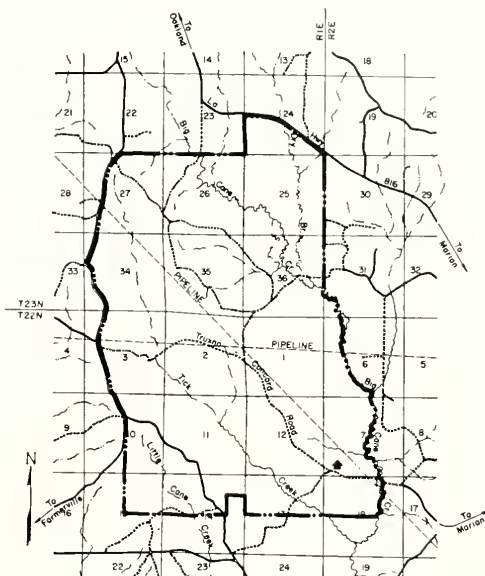
UNION PARISH
GAME MANAGEMENT AREA

CURTIS L. HOLLIS
Area Supervisor

Land for this area is leased through the cooperation of Olin Mathieson Chemical Corporation and several smaller landowners. This Game Management Area was established in 1949 for the purpose of

managing the existing wildlife species on the area and establishment of huntable deer and turkey populations which were released on the area.

The Union Parish Game Management Area which comprises an area of approximately 10,000 acres is located in the north central portion of Union Par-



UNION GAME MANAGEMENT AREA

Scale
0 2
Miles

LEGEND

--- Boundary
--- Streams
--- Intermittent streams
--- Improved road
--- Unimproved road
■ Overnight cabin

Drawn Sept., 1959

ish. This area contains second growth loblolly, and short leaf pine and mixed hardwoods with a moderate to heavy growth of underbrush. Selective cutting timber operations are being conducted on the area by landowners. Topography is rolling hills with top soil of sandy loam of the forested coastal plain type.

Food Plots

After the establishment of the Union Parish Game Management Area five food plots totaling 25 acres were cleared, fenced and planted to supplementary deer and turkey foods. During the past two years these plots have been maintained and planted to oats, crimson clover, vetch, white dutch clover and bahia grass. Food plots were fertilized at the rate of 400 pounds of 8-8-8 per acre.

Turkey walk-ins were constructed on four of the five food plots during this period. To construct these walk-ins a pit was dug six feet long, six feet wide and three feet deep along the fence edge. After the pit was dug creosote poles were placed across the pit at six inch intervals in cattle gap

fashion. This enables turkeys to walk across the gap but discourages hogs and cattle. Deer are able to jump the fences and occasionally turkeys fly over. This method of entrance gives better utilization of the plots.

Twenty salt licks are maintained throughout the year for deer. Ten to twenty pounds of salt per lick is used at each salting. Time of salting is once in the early spring and once in the fall of each year.

Deer

Prior to the establishment of this Game Management Area there were no deer in this portion of Union Parish. After the inauguration of the project 67 deer were released on this area. Releases were made from 1949 to 1951 and have been most successful; the deer herd has increased to a hunt-able population.



12 point buck deer on Jackson-Bienville Game Management Area during 1959 season.

Controlled still hunts for deer were conducted on the Game Management Area during the 1958-59 and 1959-60 hunting seasons. Each year a three-day buck only season was held. Both hunts were considered very successful with regard to the number of deer killed. A breakdown of each year's results are as follows:

Season	No. of Hunters	No. of Deer Killed	Ave. Live Wt. of Deer Killed	Ave. Wts. Body Cavity Comp. Empty	Ave. No. of Points
1958-59	1,410	24	149	111.6	7.27
1959-60	1,194	20	138.4	108.9	6.05

The 1958-59 season was conducted January 3-5, 1959 inclusive and the 1959-60 season was held on

November 28-30, 1959 dates inclusive. Both hunts were hindered due to inclement weather.

A fair representative group was killed in each age class from the 1½ year to 9½ year group. Largest individual was one 235 pound live weight deer with nine points in the 4½ year class.

Squirrel

Squirrel hunts have been conducted each year on the Union Parish Game Management since 1955 with the exception of the 1956 season. Hunts conducted the past two seasons have been successful and results are as follows:

	Season	
	1958-59	1959-60
No. of Hunters.....	178	281
Gray Squirrels Killed.....	291	601
Fox Squirrels Killed.....	52	59
Total No. of Squirrels Killed.....	343	660
Avg. Kill Per Hunter.....	1.92	2.34

Hunts during the 1958-59 season were conducted from October 4-10, 1958 dates inclusive. The 1959-60 season was held October 18-30, 1959 dates inclusive. Only still hunts were permitted.

A total of 133 squirrels have been trapped and ear tagged on the area thus aiding travel and movement studies. Hunters participate in gathering this information by returning ear tags to the check station operators and giving the location of where he made the kill.



Ranger, James Hamilton, checking squirrels killed on Union Parish Game Management Area controlled hunt during 1958-59 season.

Turkey

During the preliminary investigations on the establishment of this area it was reported that a flock of wild turkeys used the proposed area. After the area was established 144 game farm turkeys were released during 1950 and 1951. Survival was very low on these birds; but turkeys are on the area, and from field investigations conducted it appears that those present are probably native stock. These birds are reproducing at a fair rate but game management practices are being conducted to increase the flocks.

Road and Boundary Maintenance

Boundaries around the Game Management Area have been maintained in good order. Game Management Area Supervisor Curtis L. Hollis repaints boundary lines where needed prior to each hunting season.

The Commission's D-7 dozer was used on the area for road maintenance during this period. Approximately eighteen miles of road was worked with the dozer. This included seven miles of main roads and eleven miles of side roads.

Eighteen miles of road was maintained by use of the Ford 860 tractor and Danuser all Purpose Blade. Due to heavy logging operations on the area much time was spent in keeping the roads in a travelable condition.

By use of the Commission's Ford dump truck Game Management Area Supervisor Hollis hauled 114 five-yard loads of pit run gravel for roads. This was a total of 570 yards of gravel all given to the Commission by the Union Parish Police Jury for use on the Game Management Area.

Nine culvert crossings were placed on roads in the area. Forty linear feet of 15 inch, and 24 linear feet of 12 inch concrete culvert were purchased for this work. The Louisiana Department of Highways gave 114 linear feet of 18 inch and 14 linear feet of 14 inch used metal culverts to the Commission for use on the Union Parish Game Management Area.

The Union Parish Police Jury assisted on road work in the area by assigning a D-12 road grader and driver to work along with the Commission D-7 dozer and driver. With this combination the roads were put into very good condition and will assist the hunters during the controlled hunts.

Miscellaneous Activities

The overnight cabin was maintained in good order during this period. The cabin was used regularly by field personnel, students, and scout groups.

Olin Mathieson Chemical Corporation Forestry Department donated lumber for an additional room to the cabin.

Acorn Mast Studies continued on the area during this period along with squirrel trapping and tagging for movement studies.

SOIL SCARIFICATION ON PUBLIC ACCESS LANDS

JOE L. HERRING
District Game Supervisor

CHARLES R. BAUR
Biological Aide

Scarification on public access land was conducted on Olin Mathieson Chemical Corporation land in Jackson Parish.

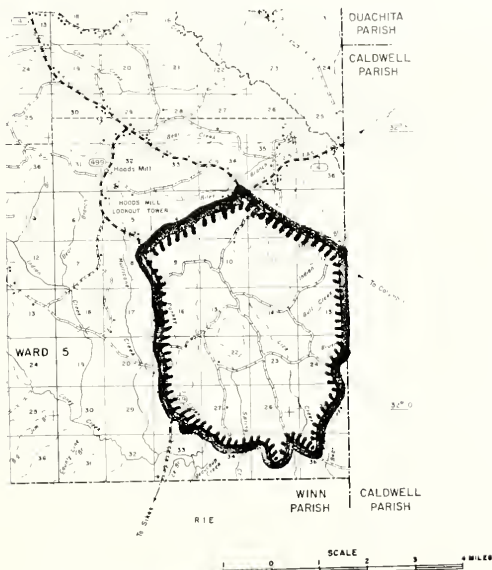
During this period of work 226 plots were disked in an area of approximately 11,520 acres. Length and width of strips varied from six feet to 72 feet in width and 30 feet to 450 feet in length. Size of plots varied because of timber stands, individual trees or other unavoidable objects. All strips were

disked in relation to proper cover and dispersal of the areas for good game management practices.

One of the simplest and most effective ways of increasing quail food consists of managing agricultural or forest lands in such a manner that native food plants are encouraged. This may be accomplished under certain conditions by either controlled burning or disking.

Disking in woodlands or old fields is sometimes helpful in encouraging annual plants of value as quail food. Following are some of the most valuable of the many quail food plants that result from reduction of perennial vegetation through disking or burning:

1. Partridge peas (*Chamaecrista* spp.)
2. Beggarweed (*Meibomia* spp.)
3. Bush clover (*Lespedeza* spp.)
4. Panic grass (*Panicum* spp.)
5. Croton (*Croton* spp.)



Outline map of the Jackson-Bienville Game Management Area.

Usually the principal quail management problem of woodlands is that of supplying adequate food. There is normally too much rather than too little cover. It is advisable in many instances to supplement native foods in woodlands by planting food plots. In an effort to provide additional quail food in this area 89 plots were planted to annuals or perennials.

Planted To	No. of Plots	% of Total
1. Sesbania (Annual)	43	19.02
2. Lespedeza bicolor (Perennial) ..	15	6.64
3. Kobe lespedeza (Annual)	14	6.19
4. Brown Top Millet (Annual).....	17	7.52
5. Plots not planted	137	60.63
	226	100.00%

It is realized that the planting of annuals and perennials, if successful, will provide benefits to

quail a short period of time, possibly three to five years.

After approximately one year of operation in this area it was determined that desired results were not being obtained. This was due to many factors, but primarily to the fact that the physical features, including forest cover, were not particularly well adapted to this type of habitat improvement and the area supported a number of free range cattle. Consequently, this activity has been discontinued in this particular area.

DISTRICT III

CLYDE E. HARRISON
District Game Supervisor

ROLAND P. VERNON
Biologist

RAYMOND C. PALERMO
Biologist

The period of this report, 1958-1959 should be well remembered by sportsmen in this State and will certainly be noted by most of the other states. More particularly, the event occurring on November 23, 1959, the *first any deer* hunting seasons in the State on four Game Management Areas in this District was a great step forward in the realm of game management. This step has been needed for several years in various areas of the State and in spite of some objections the Louisiana Wild Life and Fisheries Commission opened these areas as well as two other GMA's to all comers. Hunter response to all but one was gratifying and to those working the permit stations, it seemed endless. Of the 6,355 hunters that turned out for the any deer season all but 362 entered three of the areas in this District. A total of 519 deer were taken from 103,000 acres for an average of one deer per 200 acres. One of every twelve hunters bagged a buck or doe.

Another item of prime importance to Louisiana Sportsmen is the apparent success of a few turkeys released in the spring of 1958 and increased with another small release in the spring of 1959 on the Red Dirt G.M.A. In 1958, the annual quail food planting program was modified to aid in the survival of the turkeys and in 1959, the turkey picture looked so good additional food plots were cleared and planted. Currently, enough land on this area has been marked, and work is now in progress to double the acreage to be devoted to supplemental turkey food plots. The current aim is to have about 400 acres in plots of this nature. If all goes well, these turkeys will be used to establish flocks over the rest of the state as well as afford another form of managed hunts on the G.M.A.'s. The Commission trapped ten hens and one gobbler in the two years and moved them to Red Dirt where their numbers have increased to around one hundred.

A brief report on the District III Management Areas follows:

SABINE GAME MANAGEMENT AREA NO. 1

LLOYD C. ALFORD
Area Supervisor

Located in central Sabine Parish, this area of 8,000 acres of predominantly pinelands is of private

ownership leased to the Commission. Never having developed a deer herd of enough consequence to attract hunters to a managed deer hunt, it has been opened for the past two years for deer hunting concurrently with the short season in Sabine Parish. An estimated ten deer were killed during the seven day season in 1958 and about fourteen killed during the fourteen day season in 1959. Due to the low squirrel population and resulting lack of interest on the part of sportsmen, no squirrel hunts were scheduled during the period of this report.

The area manager maintains woods, roads and boundary throughout the year.



Buck killed on Sabine No. 2 Game Management Area.

SABINE GAME MANAGEMENT AREA NO. 2

LLOYD C. ALFORD
Area Supervisor

This area of 12,000 acres of pinelands and hardwoods is located in west central Sabine Parish and is leased to the state by private landowners. This area has been under management for the past five years only and as far as age is concerned is one of the youngest. The managed squirrel hunt in 1957 did not attract but seventy-seven hunters in fourteen days, therefore no hunts have been scheduled since. It will probably be opened for a few days in 1960.

On November 21, 22 and 23, 1959 this area was opened for a managed still hunt for deer. The first two days were for legal bucks and the 23rd for any deer. Hunter turnout was poor with a correspondingly low deer kill. For the three days 898 hunters killed twenty-one deer for an average of one deer per 45 hunters. With a larger number of hunters the kill per hunter should have approached the District average of one deer per every twenty-two hunters on the management areas.

Routine activities on this area include road, boundary and bridge maintenance.

EVANGELINE GAME MANAGEMENT AREA

HORACE STILES
Area Supervisor

The Evangeline Game Management Area is located on U. S. Forest Service lands in south central Rapides Parish. It contains 15,000 acres of second growth longleaf and loblolly pines and mixed pine and hardwoods. The State was given authority by the Forest Service to put this area under game management in June of 1949.



Game management area supervisor, Horace Stiles, checking buck killed by bow and arrow hunter on Evangeline archery hunt.

Deer—Though not regarded highly from a deer range standpoint, two managed hunts have resulted in a kill of 135 deer. These two hunts afforded 3,718 hunting efforts. All but sixty-two were killed during the three day legal buck hunt in 1958 and the two day legal buck hunt in 1959. The sixty-two were killed on the half day any deer hunt in 1959.

Not included in the above figures are the four bucks killed by archers in 1958 and 1959. In 1958, 180 archer efforts were made during the seven day season with a kill of one buck with bucks only being legal. In 1959, with any deer being legal, 567 archer efforts resulted in a kill of 3 bucks. The 1959 archery season was for ten days and preceded the managed gun hunt as did the 1958 hunt.

During the winter and spring of 1958-59 a deer trapping program was initiated and fourteen were trapped. Twelve were ear tagged and collared, and one was ear tagged only. All were released at the



Archery hunters' camp at Evangeline Game Management Area.

trap site. During the managed hunt four deer with ear tags were recovered. All of the four had lost the collars. The object of this activity was to check movement and populations based on hunter and trapping returns. The sample was too small to be of much value. About forty acres of winter deer foods are planted annually to attract deer and make them more available to hunters. Unfortunately, the hunters use these five acre plots as parking areas and no deer are killed on them.

Squirrel—The length of the managed squirrel hunts has been shortened considerably due to the expense of operation. Squirrel range is limited and few hunters respond to the hunts. In 1958 during

the three day hunt, 179 hunting efforts resulted in a kill of 135 squirrels for an average of .75 squirrels per hunter. In 1959 hunter success was a little better with an average kill of 1.2. During this three day hunt 175 hunting efforts were made.

Quail—The heavy grazing pressure exerted by privately owned livestock on this area preclude extensive quail development. However, for the past few years it has been hunted annually for a few days. During the 1958-59 quail season three managed hunts of three days duration, were held. The 183 hunters took a total of 255 birds with an average bag success of 1.39 quail. Hunts are scheduled for the 1959-60 season but at the time of this report have not taken place.

Quail development is almost entirely limited to winter food plantings.

General—The area manage maintains jeep roads and bridges, the yard around the area cabin and the boundary.

GRANT—RAPIDES GAME MANAGEMENT AREA

T. EARL DEEN

Area Supervisor

This game management area was initiated in March of 1950. The lease, from Urania Lumber Co., will terminate in 1960. This area comprises a total of 7,700 acres of Red River bottomlands which are generally flat and poorly drained. About 6,000 acres have an excellent stand of mast producing hardwoods with a heavy stand of undergrowth.

Deer—There were no deer present on the area when it was taken under management. Fifty were released in 1950-51 and the first deer hunt, for three days was held in 1959. As on all other areas it was a still hunt, and was for legal bucks only. Here, 1,014 hunters took thirty five legal bucks during the three day period. Roughly, one out of thirty hunting efforts was successful.

Squirrel—During the managed squirrel hunts on this area in 1955, 1957, 1958 and 1959, a total of 5,727 hunting efforts have been made with 10,686 squirrels having been taken. Over the years the kill per hunter effort has averaged 1.8 squirrels. This average has ranged from the high of 2.1 in 1955



Buck killed on Grant-Rapides Game Management Area during 1959-60 season.

to a low of 1.4 in 1958. For the past three summers, squirrels have been trapped, ear tagged, and released at the trap site. The resulting information gained both through retrapping and returns from the managed hunts has been of great interest. A detailed account of this activity will be found in the squirrel Study Leader's report.

General Activities—Boundaries and the area cabin are maintained throughout the year. Due to the topography of this area, roads have not been developed.

CATAHOULA GAME MANAGEMENT AREA

VOLMER BOWEN

Area Supervisor

The Catahoula Game Management Area is on U. S. Forest Service lands in Winn and Grant Parishes. It is about 40,000 acres in size with a forest composition of primarily loblolly and shortleaf pine and a small amount of associated hardwoods. The topography varies from gently rolling hills to poorly drained flats with but few streams. The State initiated game management practices on this area in 1949.

Deer—Deer were present in 1949 and the forests immediately surrounding the G.M.A. were affording fair deer hunting. As early as 1954 it was felt that a deer harvest should be made on this area. Local opposition prevented deer removal through hunting or trapping. In 1957 a five day managed still hunt was held with 1,301 hunting efforts and a kill of twenty-six bucks. In 1956, forty-eight deer were trapped and removed. In 1959, hunts were held for legal bucks for five days and one day for any deer. During this six day period 6,399 hunting efforts were made with a total kill of 354 animals with 37 per cent females.

Squirrel—Managed squirrel hunts have also been opposed locally and only three have been held. The only one occurring during the period of this report was in 1959 and was for five days. During this hunt, 1,094 squirrels were taken with 434 hunting efforts for an average bag of 2.5 squirrels. Although the total kill was less than either of the previous hunts, the kill per hunting effort was greater. During the preceding hunts the hunters were under the mistaken supposition that the G.M.A. carried a greater population than the ordinary forests and came to the area in much greater numbers.

General—Boundaries, jeep roads, and the area cabin were maintained in good condition. Various species of oaks are under study for acorn production.

RED DIRT GAME MANAGEMENT AREA

H. C. BEASLEY

Area Supervisor

The Red Dirt Game Management Area, approximately 40,000 acres in size, is located on U. S. Forest Service lands in the south central section of Natchitoches Parish. The area contains a variety of timber types, primarily long leaf pine which is found in pine stands ranging from seedlings to mature timber, mixed pine and hardwood, and a very small amount of bottom land hardwoods. The topography varies from gently rolling hills to rugged outcrops of sandstone. Probably the most nearly mountainous country in Louisiana is found on Red Dirt. The elevations are not too great but the sharp changes in elevations found in the north eastern section of this area are most unusual for Louisiana.



Deer trapping on Red Dirt—1958

The State initiated its game management program here in 1948.

Deer—An estimated 250 deer were present in 1948 and this herd grew until browse studies indicated herd reduction was necessary. Trapping operations were initiated in 1954 and to date have resulted in the transplanting to other sections of the State of approximately 725 animals. These transplanted deer were placed in parishes with no deer and sportsmen began to benefit from them in 1958 as parishes having had no deer hunting in years were opened for limited periods. In 1959 there were few areas suitable for restocking and most of the deer trapped were ear tagged and collared and released at the trap site.

In 1955, 1957, 1958, and 1959 managed still hunts for deer were held. In each of those years five days were devoted to hunting legal bucks and in 1959, on the day following the buck hunt, hunters were permitted to kill any deer. During the hunts for the four years 14,471 hunting efforts were made with a kill of 558 legal deer. During the one day when any deer were legal, 2,500 hunters took 227 animals. Of the 227, 48 percent were females. A discussion of marked or tagged deer will be found in the Deer Study Report.

Quail—With the gradual ageing of the pine forest of this area, the quail development program is necessarily curtailed. In 1948 and for several years after, this area was sufficiently open to make quail habitat improvements feasible. Limited quail food plantings are still made, but quail derive most of their benefit now from the turkey food plantings. To be really effective, quail plantings must be smaller and more numerous while plantings for turkey are most effective when fewer but larger plots are maintained. Therefore, fewer but larger food plots are now being planted. This can be better worked into timber management than numerous small food plots.

Managed quail hunts were held in 1955, 1957 and 1958 for a total of thirty-five days. In all, 570 hunting efforts were made with a total bag of 1,168

birds. The 1959 quail hunt has not been completed at the time of this report.

Squirrel—This area has so little squirrel range that no hunts have been scheduled in recent years.

Turkey—As mentioned earlier, the Commission live trapped ten hens and one gobbler in the spring of 1958 and 1959. Hasty supplemental food plantings were made and feed was made available to them. In 1958 and 1959 supplemental food plantings of brown top millet, chufa, wheat and bahia grass were made. In addition, areas within the woods were mowed. At the present time the turkeys have not scattered on the area in a satisfactory manner. If the spring census shows that they have not dispersed better, they will be trapped and placed in other sections where supplemental food plots have been prepared.

General—Numerous studies related to the research phase of game management are conducted on this area. A discussion of each will be found in the research section of this Biennial report.

As on the other G.M.A.'s routine activities include road, bridge, fence, and boundary maintenance. In addition, over the years a fair selection of wood working tools as well as welding equipment has been collected and quite often the Area Supervisor and his crew construct needed equipment.

Quail Development on Public Access Land—During the 1958-59 fiscal year the Louisiana Wild Life and Fisheries Commission entered into an agreement with the U. S. Forest Service whereby the Commission would develop suitable lands within the Vernon Division of the Kisatchie National Forest in Vernon Parish for quail. This area is now open to quail hunting during the open season and will continue to be.

Development will consist of disking strips within this forest and when soil types are suitable, common lespedeza will be planted. On poor soils natural plant succession will provide a limited amount of quail foods. The important thing is to disturb the soil so that natural quail foods, primarily legumes, will take the place of the grass which provides no food. In addition fire will be used to remove thick grass stands and cover will be provided both through plantings and through protection of natural cover from fire.

So far, equipment has been purchased to do some of the work and aerial photos of the area have been secured. Actual work is scheduled to begin in early 1960.

DISTRICT IV

DEWEY WILLS

District Game Supervisor

C. T. WILLIAMS

Game Biologist

CALDWELL GAME MANAGEMENT AREA

WELCH LIVELY

Area Supervisor

The lease on the Caldwell Game Management Area expired in 1959 and was not renewed. The area under its present condition was of little value



Cattle on Caldwell Game Management Area.

to the Louisiana Wild Life and Fisheries Commission and the sportsmen of the state. Range conditions are critical as a result of over-grazing by livestock; the deer herd has reached its carrying capacity, and only 4 or 5 turkeys remain as the result of restocking with pen-reared birds. This area could be utilized to its fullest extent as a game management area by improving range conditions through the control of domestic livestock and the development of overflow areas for waterfowl. To make



Contrast between fenced and unfenced range (cow, hog and deer type of enclosure) Caldwell Game Management Area.

these improvements the entire area should be fenced and a series of low water control structures should be constructed to permit manipulation of the water levels to make the area more attractive to waterfowl. Nebo Oil Company, owner of this land, when approached on these two proposals, refused to grant permission to accomplish this work.

Prior to the expiration of the lease the area supervisor performed routine duties as outlined under the maintenance and development plans for the G.M.A. The 5 food plots were mowed each year, approximately 14 miles of new jeep roads were cleared, 5 miles of old jeep roads maintained, and the entire boundary line around the G.M.A. was brushed out, re-painted, and boundary markers replaced where needed.

Managed Hunts

This G.M.A. has been hunted only 4 times since its establishment. Three times for squirrel and once for deer. The controlled hunt for deer in 1959



Close-up view of the dense understory that has developed within the enclosure.

did not materialize as the lease on the area was not renewed. (Editor's Note: Lease has since been renewed.)

1958

Squirrel. During October the area was opened for a 7 day squirrel hunt. No permits were issued; however, spot bag checks indicated that hunters were very successful.

Deer. A 7 day deer hunt (bucks only) was held in December in conjunction with the deer season on surrounding areas. No permits were issued and hunters were not required to check their kill. The area supervisor reported a kill of approximately 45 deer.

1959

Squirrel. This controlled hunt was conducted during the first 7 days of the regular squirrel season. A total of 168 hunting efforts were made and 420 fox squirrels were killed. The average kill per hunter was 2.50 squirrels.

A good mast crop was present on the area and squirrels were plentiful. Hunter success was hampered by squirrels being on the ground due to an early mast fall. Had the season opened on October 1, it is believed that more squirrels would have been harvested.

LaSalle Quail Development Area

Since 1955, the Louisiana Wild Life and Fisheries Commission has carried on a quail development project in LaSalle Parish for experimental and demonstration purposes. This area is located north of Jena on lands owned by Nebo Oil Company. Twenty-five food plots were established and various types of quail food plants have been planted on this area. The area is open to the public for hunting and is used extensively by hunters from all over the State each year.

1958 Food Plantings

Prior to 1958, various types of food plants were planted. In 1958, only browntop millet was planted in the plots. Fertilizer rates were different from preceding years as three types of fertilizer were used: Commercial 8-8-8, 3-12-12, and basic slag.

Since the quail area is actually divided into 2 sections (12 plots on the west side and 13 on the east side), the different fertilizers were applied equally to plots on both sides.

Fifteen plots were seeded entirely to browntop millet, five plots were left unplanted, and 3 were seeded to browntop in strips. Entire plots or portions of plots which were not seeded in 1958 were left unplanted to determine the degree of re-seeding from 1957 plantings and to determine the feasibility of different types of fertilizers.

Due to inclement weather, preparation of the food plots was late and ground litter plentiful. Yet, stands of planted foods (browntop, chocolate weed, and goatweed) were numerous. If the food plots had been prepared earlier a better stand of sesbania, goatweed, and chocolate weed would have occurred. But, due to weather conditions plot preparation was delayed and many seed from the previous year had sprouted.

1959 Food Plantings

Kobe lespedeza and browntop millet were the two food plants seeded this year. Results from past plantings have shown that browntop is a desired quail plant. Kobe lespedeza is being tested to indicate feasibility and practicability in cut-over long-leaf pine country. This is the first year this plant has been seeded on the quail area.

One-half of each plot was seeded to browntop and one-half to lespedeza. Field inspections on the area later in the summer showed good stands of goatweed, chocolate weed, and sesbania in spots. This resulted from natural re-seeding from previous plantings. Browntop stands in most plots were good. Kobe lespedeza stands were poor during the early part of the growing season, but became much better as summer progressed.

The plots can be rated as good this year based on the variety of foods available to quail. Seed maturity occurred at several intervals since some plants were faster growers and others had the ability to produce seed even though they were retarded by shading and other plant competition.

DEER TRAPPING - MADISON PARISH

DEWEY WILLS

District Game Supervisor

C. T. WILLIAMS

Game Biologist

Deer trapping has been an annual operation within the north central portion of the Chicago Mills Refuge since 1955. Each year trapping has been held to a minimum because of bad access roads and inclement weather conditions during January and February. Therefore, the number of traps used has been necessarily held to a minimum.

A total of 99 deer were trapped during the 2 year period: 38 bucks and 61 does. Of this number 21 were tagged and released at the trap sites for deer movement studies, 5 does were collected for reproductive studies, and 73 were used for restocking purposes. The areas restocked included parts of Richland and Ouachita Parishes. In Richland Parish 36 deer (11 bucks, 25 does) were released northwest of Rayville. Within Ouachita Parish 37 deer (8 bucks, 29 does) were released 10 miles southwest of West Monroe.

The sex and age classes of deer trapped during this period are shown in Tables I and II.

TABLE 1

Sex and Age Classes of Deer Trapped During 1958

Sex	Age Classes										Total
	3 mo.	4 mo.	5 mo.	6 mo.	7 mo.	1½ yrs.	2½ yrs.	3½ yrs.	4½ yrs.	5½ yrs.	
Female	1	1	3	10	2	7	5	9	6	1	55
Male	1	1	2	4	2	7	4	2	2		30
Total	2	2	5	14	4	14	9	11	8	1	85

TABLE II

Sex and Age Classes of Deer Trapped During 1959

Sex	Age Classes							Total
	6 mo.	6-7 mo.	7 mo.	7-8 mo.	3½ yrs.	5½ yrs.	Unknown	
Female					2	1	3	6
Male	2	1	3	1	1			8
Total	2	1	3	1	3	1	3	14

CHICAGO MILLS GAME MANAGEMENT AREA

JIM PERRITT
Area Supervisor

The Chicago Mills G.M.A. is located in the western part of Tensas Parish and comprises 29,500 acres of bottomland hardwood habitat. During the past two years the work programs as outlined under Federal Aid Projects have been carried out. This included boundary maintenance, brushing out of old and new jeep roads, habitat improvement for turkeys, controlled hunts for squirrel and deer, and the collection of doe deer for reproductive studies.

Area maintenance performed consists of the erection of 800 boundary markers, repainting of 35 miles of boundary line, brushing out of 25 miles of old jeep roads, construction of 5 miles of new jeep roads, and marking off and erecting signs around approximately 5,100 acres due to oil field installations. Prior to the 1959 deer season signs around this closed area were removed and the entire G.M.A. was hunted.

Managed Hunts

Managed hunts for squirrel and deer were carried out in 1958 and 1959. The results of these hunts are shown below.

1958
Squirrel. The area was open to squirrel hunting from October 4 through October 10. No permits were required and the only request made of the hunters was to observe all existing game regulations. Spot checks on the area revealed that hunting was poor. The mosquito population was extremely high and this probably contributed to poor hunting success to some extent. Many hunters quit shortly after en-

tering the woods because of the pests.

Deer. During December 1958 a five day controlled antlerless deer hunt was held. A total of 2,105 hunting efforts were made and 183 deer were killed. The number of hunting efforts each day, followed by their kill, are as follows: 828-63; 374-47; 385-27; 279-14; 239-32. Hunter success was definitely hampered by poor access to the area and low water conditions on Tensas River. These two factors caused uneven hunter distribution and limited hunting pressure to the outer fringes of the game management area.

1959

Squirrel. A 7 day managed squirrel hunt was held from October 17 through October 23. A total of 253 hunting efforts were made and 718 squirrels (152 fox and 566 gray) were killed. The average kill per hunter was 2.84 squirrels. Hunting pressure was light for two reasons: (1) many local hunters were in the process of harvesting farm crops during this 7 day period, and (2) access to the area was poor; this confined the hunters to the river banks and outer fringes of the area.

Deer. A ten day controlled hunt was held from December 1 through December 10. The season was divided into 2 segments: (1) a 3 day any deer hunt (Dec. 1-3), and (2) a 7 day bucks only hunt (Dec. 4-10). A total of 566 deer were killed and 4400 hunter efforts were made on the area. Three check/permit stations were operated at the most strategic points.

Blood samples, reproductive tracts, and liver specimens were collected by Biologists and Dr. H. M. Tate (School of Vet. Medicine, University of Georgia) for State deer investigation projects and the Southeastern Cooperative Deer Disease Study.

The number of hunting efforts per day and daily kills are as follows:

Date	Hunter Efforts	Deer Killed
Dec. 1	1651	248
2	1038	169
3	991	131
4	135	7
5	182	1
6	149	3
7	65	1
8	67	2
9	74	4
10	58	0
	4400	566

During the 3 day any deer hunt a total of 3680 hunting efforts were made and 548 deer were killed. Only 18 bucks were killed during the last 7 days in which bucks only were legal. Hunting pressure dropped off sharply after the any deer hunt. During the last 7 days only 720 hunting efforts were made.

Hunter success was greater in 1959 due to more favorable access conditions. The use of Chicago Mills and Lumber Company Newlight Oil Field roads enabled many hunters to hunt deer in areas not accessible during the controlled hunt of 1958. Contacts with Chicago Mill field personnel indicated that the use of their roads by the hunters was sat-

isfactory and that the program was carried out in an orderly manner.

Habitat Improvement—Turkey

Originally, development plans called for the establishment of 11 plots comprising 11 acres. Due to inclement weather only 6 plots totaling 5.5 acres were established. The areas were disked in August and planted September 28, 1959.

Three plots were fenced with 4 strands of barbed wire and 3 left unfenced. The other 5 plots will be established next spring.

Only wheat, oats, and pensacola Bahia grass were seeded in each plot this fall. The plots were actually seeded as following: one-half of each plot to a combination of wheat and Bahia, and one-half to oats alone. In the spring of 1960, each one-half plot previously seeded to oats will be seeded to browntop millet. Only one-half of the oat strip will be planted at a time. The second planting of browntop will be 6 to 8 weeks later than the first planting. This, along with the fall planted Bahia, should give a complete food plot.

Good stands of wheat and oats were obtained. Field trips to the plots in later October and early November revealed heavy use by deer. Inspections after the controlled deer hunt in December showed ample stands of oats and wheat.

Reproductive Studies—Deer

Eleven adult does were collected between February and May 1959 for reproductive studies on white-tail deer. Blood samples, reproductive tracts, and the lower jaw bone were obtained from each animal and sent to the deer study leader for analysis.

DISTRICT V

JACK A. SIMS

District Game Supervisor

JAMES ILES

Biological Aide

This report covers development work in Pittman-Robertson District V during the period from Janu-

ary 1, 1958 to December 31, 1959.

The work done was confined to the West Bay Game Management Area and the DeRidder Air Base Public Shooting Area. The work done on these two areas will be discussed separately.

West Bay Game Management Area

E. E. Garlington, Area Supervisor

The West Bay Game Management Area consists of 18,500 acres and is located in Allen Parish three miles south of Elizabeth, La.

During the fiscal year of 1958 the work done on the area consisted of boundary and road maintenance. A segment of the Oak Mast Production Study was also carried on during 1958 and 1959 on the area. This work consisted of collecting acorns from selected trees during the fall and winter.



Deer hunters ready and waiting at the permit station on West Bay GMA.



"Scotty" Goudeau, Biological Aide; Jack Sims, District V Game Supervisor, Jimmy Iles, Biological Aide, checking plans for managed hunt on West Bay Game Management Area.



Howard Hebert of Lake Charles with eight-point, 155 pound buck killed on West Bay Game Management Area.

During the summer of 1959, five food plots were planted to winter food crops for turkeys. The plots are approximately five acres in size, and are fenced against livestock. The entire plot was not planted, but strips were planted to oats, rye grass and wheat leaving alternate strips for cover. There has been a slight increase noted in the turkey population on and around the area during the past two years. For this reason, the food plots were planted in an effort to continue this increase of turkeys.

For the first time since the Game Management Area was established, a managed deer hunt was conducted. This was a three day still hunt for legal bucks only, and was conducted on November 28, 29, 30, 1959. A total of 2,760 hunters bagged 72 deer during the hunt.

DeRidder Air Port Public Shooting Area

This area is 800 acres in size and is located on the DeRidder Air Port five miles west of DeRidder, Louisiana. The land on which the area is located is



"Scotty" Goudeau examining teeth of buck to determine age, part of biological data obtained from controlled hunts.

owned by the Beauregard Parish Police Jury.

Ten food plots, totaling approximately ten acres, are planted each year. During the past two years, all plots have been planted to Browntop Millet. The plots are planted primarily for dove and quail.

This area is open to the public every other day during any legal season, beginning with the dove season. No permits are required to shoot on the area.

DISTRICT VI

J. B. KIDD

District Game Supervisor

W. A. GOUDEAU

Biological Aide

Thistlewaite Public Hunting Area

Although this excellent hardwood area has been under the supervision of the Wild Life and Fisheries Commission since 1950, it was not until 1958 that the hunters of the state realized any value from the

area. The Thistlewaite public hunting area is located in St. Landry parish about two miles north of Washington and lies within the drainage system of Bayous Boeuf, Cocodrie, Courtableau and Waukasha. The area is a pure hardwood stand with a variety of oaks (which make up about 75 per cent of the stand) and other hardwoods which are conducive to good gray squirrel habitat. Some fox squirrels are found along the edges of the open fields. After it was agreed to open this area to squirrel hunting in 1958, the boundaries of this 12,000 acre area were clearly defined and marked with yellow paint and metal boundary markers.

To the enjoyment of the hunters of this area, the squirrel season was opened in 1958 on October 1 for 14 days. Each person was required to secure a permit at one of the designated permit stations. As the hunters received permits, they in turn surrendered their licenses. At the end of each daily hunt the permit was exchanged for the license and the hunters' bags checked. In this manner every squirrel killed on the area was examined.

During the 14 day hunting period, a total of 2860 daily hunting efforts were expended in search of squirrels. The hunters netted a total of 5589 squirrels for an average kill per hunting effort of 1.95 squirrels. This total kill was the greatest ever achieved on any area in the state where this type of hunt was conducted.

The weather conditions were favorable for squirrel hunting during this period, but the hunters were plagued with an unusual number of mosquitoes. It is believed that hunter success may have been better as a number of hunters, without mosquito repellent, were forced out of the woods during the first few days of the hunt.

One of the more important contributing factors to the success of this hunt was due to the cooperation of the SOHIO Petroleum Company whose activities have created about 35 miles of good improved roads in the area. The hunters were allowed complete and unlimited use of these roads. This fact allowed good dispersal of hunters in the woods and kept hunter congestion to a minimum.

In anticipation of the 1959 season on Thistle-



Biological aide, William "Scotty" Goudeau cutting access trails in for use of squirrel hunters on Thistlewaite Game Management Area.

thwaite it was decided to make some access trails in the wooded area for hunters. Practically every acre of the area is covered with palmetto, and in a number of areas it is so dense that squirrel hunting is almost impossible.

Using a Ford tractor and a 5 foot bush hog, hunter trails were cut through the palmetto during the 3 month period prior to the opening of the 1959 season. It is estimated that about 30 miles of these foot trails were made in the dense palmetto.

The squirrel season opened on October 17 in 1959, but was limited to half day hunting in the mornings only. A total of 2,125 individual hunts were made during the hunting period which resulted in the killing of 5,195 squirrels. The average kill per hunting effort was 2.45 squirrels. The hunters welcomed the access trails and reports indicated that they were used considerably. The weather conditions were again favorable for hunting and the mosquito population was at a minimum.

Although the total number of squirrels killed was smaller in 1959 than in 1958, the average hunter success increased from 1.95 squirrels in 1958 to 2.45 squirrels in 1959. It was also noted in the animals examined, that the proportion of juveniles in the 1959 bag was much higher than 1958. This indicates an *increasing population*, which was no doubt due to the good mast production in 1958. The mast production in 1959 is again good and it is believed that the Thistlethwaite area will reach the highest carrying capacity of squirrels in 1960 that the range will ever allow. This all points to an excellent hunting season in 1960; one that should exceed the two previous years of 1958 and 1959. It is also planned to maintain the present access trails and to add even more in the future for the hunter's benefit.

A Comparison of Hunter Success

1958 & 1959

Year	No. Hunts Made	Fox	Gray	Unknown	Avg. Kill per Hunting Effort
1958	2860	562	5020	7	1.95
1959	2125	456	4725	14	2.45

DISTRICT VII

HENRY D. ROBERTS

District Game Supervisor

Supplemental Quail Food Plantings On Public Access Lands

This work is a continuation of a project begun in April of 1957, in co-operation with Gaylord Container Corporation. In the spring of 1958 an effort was made to establish *Lespedeza bicolor* strips on one-half of each of the 38 plots that had formerly been fenced. The remaining half of each plot was broadcast to a mixture of soybeans and browntop millet. Due to very poor quality of the bicolor plants received and to extremely rough weather conditions at planting time, very few of the bicolor strips survived. The soybeans and browntop millet produced good crops of seed, both of which were readily available to birds throughout the winter.



Plowing fenced food plots on Gaylord Container Corp. land in Tangipahoa Parish.

During the 1959 planting season, another attempt was made toward establishing a bicolor strip on the plots which had previously failed. These were much more successful. This same season the remaining half of each plot was planted to browntop millet and kobe lespedeza. These showed good stands and produced good seed crops. If this does nothing more, it at least tends to concentrate birds for the sportsman.

ZEMURRAY DEER MANAGEMENT AREA

FRED JOINER

Area Supervisor

Trapping

In January and February of 1958 ten deer, consisting of six does and four bucks, were taken from this area by trapping. Four of these went to the Gourd Bayou area of Ouachita Parish, two were released in the northwestern portion of Lincoln Parish, and two died in transit. Due to warm weather and no success, trapping was discontinued on February 15, 1958.

The 1959 trapping wasn't begun until February 18, due to lack of an approved release site for deer from this area. Twenty-two deer (14 bucks and 8 doe) were removed between then and March 15. Twelve of these were released in the Silver Creek area of Vernon Parish and ten at Rosepine, also in Vernon Parish. General body condition of the deer from this area has been fair to good, except for a heavy infestation of ticks.

No trapping was planned for this area during the latter half of 1959.

Controlled Hunting

A controlled deer hunt, for bucks only, resulted in removal of 27 deer. The hunt was held on November 16-17-18, 1959 and because the area is so small the number of hunters was limited to 100 per day. The hunt was very successful in every manner except that it did not remove the desired number of deer.

This area is heavily overbrowsed, consequently a second hunt is set up for this season. The proposed hunt will be for both sexes of deer, and will allow removal of approximately 100 more deer. One hundred and fifty hunters per day will be allowed on the area for each of the three days, or until the desired number of deer are taken. The hunt is scheduled for January 4-5-6, 1960.



Camelia bush on Zemurray park severely hedged by deer.

Improvements on Area

A (10' x 12') room was added to the Zemurray overnight cabin to afford sleeping quarters for the personnel working on the area.

Five galvanized and asphalt-treated culverts were installed, and 10 yards of gravel were spread on the roughest portions of the roads to provide access, by automobile, to all parts of the area. A minimum of 15 more yards of gravel will have to be spread in preparation for the second hunt.



Bailey live beaver trap being set by Lloyd Cutrer, beaver trapper.

Beaver Trapping

A study of the beaver in Louisiana, made by Robert Noble while a graduate student at Louisiana State University, showed the beaver to be rather well established throughout the state. The report also indicated this animal is becoming more of a liability than an asset. Low pelt prices have caused trappers to discontinue taking the beaver and with no control they are becoming serious pests.

Records maintained over the past five years show numerous complaints concerning damage to timber and agricultural crops, blocking drains, and a host of others. Further releases will only bring about more complaints, therefore live trapping and transplanting of beaver has been discontinued, as of July 1, 1959. The only beaver trapping done at present is by use of Victor No. 2½, or by Victor Conibear



Dynamiting troublesome beaver dam in Florida parishes.

traps, as a result of complaints of beaver damage. Quite frequently the beaver dams are "blown out" with dynamite and the site treated generously with creosote as a repellent in an effort to move the beaver out of the area without having to try to trap them. In many cases this has proven quite successful. However, like trapping, it has its limitations as to permanency of relief from beaver troubles. If rains are scarce, and water levels low after such treatment, the creosote odor seems to be quite effective as a repellent. A single heavy rain can easily void all such efforts expended, unless there has been such a large portion of the dam destroyed that the beavers are discouraged from trying to repair the break (and they don't discourage easily!).



Turkey gobbler killed north of Liverpool in St. Helena parish, April 1958, being weighed by ranger, Capt. Leonard New and data recorded by Kenneth Smith.



Turkey killed 1958 season, St. Helena parish.

DISTRICT VIII
ROBERT A. BETER
 District Game Supervisor

PUBLIC SHOOTING GROUNDS

Two coastal waterfowl public shooting grounds have been acquired by the Pittman-Robertson section of the Louisiana Wild Life and Fisheries Commission. These two areas are comprised of approximately 70,000 acres. Considering the extreme diversity in location, vegetation, and development aspects, these two waterfowl areas will be treated as separate entities.

Biloxi Marshlands Public Shooting Grounds
Project W-33-D

This area comprising 40,000 acres of good waterfowl area along coastal Louisiana, was acquired October 1, 1958.

This marsh area lies approximately 30 miles



Earthen levee being built up by dragline on Wisner area.

southeast of New Orleans in St. Bernard Parish. The tract is bounded on the north by Lake Borgne, on the east by a zig-zag line starting from Lake Borgne, approximately half a mile east of Bayou Hasouse and running south to the north side of Bayou Loutre, on a quarter mile east of Engineer's Canal, thence along Bayou Loutre to a point three-quarters of a mile north of Isaac's Ditch, thence east to a point one and one-half miles northwest of Crooked Bayou, thence north through Lake Eugenie and Bob's Lake, west through Lakes of Bayou Morron, and thence northeast to Lake Borgne and terminating at a point approximately one-quarter mile south of Bayou LaFee.

The boundaries of the Biloxi P.S.G. were marked during August of 1959. A marsh buggy was used to facilitate setting out over 400 boundary posts and signs. Signs were placed around the boundary 650 feet apart.

This marsh is accessible from almost any direction. Access points are as close as Shell Beach, Dollut's Canal, Yskloskey and Hopedale. Larger boats take the more direct route south across Lake Borgne from Chef Menteur and the Rigolets.

The interior marsh is a labyrinth of bayous, lagoons, ditches and ponds. Nearly every pond and lagoon has an abundance of aquatic such as widgeongrass, southern naiid, and coontail. Diving ducks and puddle ducks (scaup, mallards, teal, gadwalls and baldpate) come into the ponds to feed. Upon the shores and marsh proper come thousands of blue and snow geese to feed upon the new shoots of three-cornered grass following burning procedures.

Isolated ridges which now lie dormant stand as mute testimony of the old distributary of the Mississippi River, Bayou Loutre. Upon these ridges rabbits, deer and the ever present cottonmouth occur.

Salt water fishes such as speckled trout, redbfish, sheephead, etc. are abundant in the waters of this area and it is used heavily by sport fishermen throughout the year.



Completed earthen levee on Wisner area.

Actual physical developments are scheduled to commence in January of 1960. Present plans call for the construction of approximately 30 wooden water control structures and numerous earthen plugs. Earthen fills coupled with wooden structures will tend to stabilize water levels throughout the whole of the marsh area. Stabilized water levels should insure the annual production of submerged aquatics such as widgeongrass. Also, stabilized water levels will provide better access during winter months when northwest winds usually blow practically all the water from ponds and lagoons.

Controlled burning of the marsh will reduce the climax vegetation of wire grass, the big cord grass, and oyster grass. Growths of sub-climax vegetation of three-cornered grass and leafy three-square, which are favored by geese and muskrats, should result.

The forthcoming waterfowl season should see development operations well under way and more and more hunters taking advantage of the hunting and fishing opportunities offered.

Wisner Public Shooting Grounds Project W-31-D

This public shooting ground became active on



J. M. Johnson and D. D. Dodd working on first piling being driven for water control structure on Wisner area.

May 15, 1958. The Wisner Tract comprises 30,000 acres of potentially good waterfowl area. This public shooting ground is located in Lafourche Parish between Leeville and Grand Isle. It is bounded on the north by the Southwest Louisiana Canal, by the Gulf of Mexico on the south, by Caminada Bay on the east, and Bayou Lafourche on the west.

Boundaries were marked during August 1958 in the same manner as the Biloxi tract. During April of 1959, actual development operations were begun. During the first four months of operations, work consisted mainly of reconstructing deteriorated spoil banks along canals and bayous. Earthen plugs were made in small drainage ditches connecting small ponds or potholes. Other earthen plugs were made in bayous connecting large bays and lagoons which in turn were to be controlled by wooden water control structures.



Sheet piling being driven to complete water control structure on Wisner area.

A total of 5 wooden structures were erected during the latter part of 1959. These 5 structures stabilize water levels in approximately 4,500 acres of marsh.

Water depths in bayous, in which wooden structures are placed, range from 5 to 8 feet. The wooden structures are built with 30 foot long pilings spaced 7 feet apart and projecting into the marsh 15 feet on both sides of the bayou. Pilings are driven approximately 22 feet into the ground, thereby allowing a two-foot projection above water if the water

depth is 6 feet. Vertical pilings are tied together with a horizontal cross-walcing of overlapping 2 x 8's at the top and bottom. Next, 16 foot vertical sheet pilings of 3 thickness 2 x 8's are driven flush against the horizontal walcing.

The vertical sheet piling is built in the form of tongue and groove, this gives a tight interlocking fixture as each section is driven by pile driver and wedged tightly against the last. After all vertical



Completed water control structure during low tide on Wisner waterfowl area.

sheets are driven, another double thickness horizontal wale is bolted in the back side of each pole piling so as to hold the vertical sheet pilings in place. Development procedures and techniques are practically identical on the Wisner and Biloxi areas.

Vegetative types on the Wisner tract consist almost exclusively of the climax species of oyster grass. Controlled burning in some instances will revert this climax back to the sub-climax of leafy three-square and Olney three-square.

By courtesy of the Lafourche Parish Police Jury, three shelled boat launching areas were installed adjacent to the area. The first site is located on the

west side of Hwy. 1, near Bayou Moreau, about seven miles south of Leesville. The second launching area is located on the south side of the same highway at Dos Gris, Louisiana, about 15 miles south of Leesville. The third public launching area is located on the north side of Hwy. 1, adjacent to Bayou Fer Blanc.

Work on the Wisner and Biloxi P.S.G. is being done by segments. Approximately 6 months a year are devoted to developing each area so that there is a continuous year round development going on. Tentative plans call for the completion of development operations on both areas within three years.



Water control structure at high tide on Wisner area.

Deer Trapping

During 1958-1959, a total of 13 deer were removed from Avery Island and transported live to Calcasieu Parish, as part of a restocking program.

OYSTERS WATER BOTTOMS AND SEAFOOD DIVISION

JAMES N. McCONNELL

Chief

IN COMPARING OYSTER production in Louisiana for the past two years, 1958 and 1959, with previous years it became immediately apparent that Louisiana has reached an all time low in oyster production. This is not only the picture in Louisiana alone but with the exception of the west coast seems to be the national picture as well.

For a number of years the division chief has recognized this trend and realized that it is due to many causes, such as a long period of drought, and the tremendous increase of industrial activities in most of our best producing oyster areas. Today some of our most productive oil fields are located in areas where formerly oysters and shrimp were the only stable crop.

Another factor partly responsible for production loss is the tremendous increase in both canned oysters and shrimp from foreign countries which are produced with low cost labor and with either the poorest sort of sanitary inspection or in many cases no inspection at all. The Louisiana oyster producer has to compete for labor with the oil companies, pipe line companies, geophysical operators, barge lines, etc. These industries have shorter hours, excellent living conditions and a much higher pay scale than the oyster producer is able to offer.

One of the answers to our oyster problems seems to be additional controlled fresh water outlets from the Mississippi River on both the east and west sides which will effectively lower the salinities in our most productive oyster areas. A pilot plant of this type was constructed in September 1956 at Bayou Lamoque and the immediate beneficial result was a tripling of production in the area and an increase in yield of oyster meats from 12 to 14 cans per bbl. to 22 to 26 cans per bbl.

Lowering the salinities in our oyster growing waters will have the effect of minimizing our oyster losses from the two most serious enemies of the Louisiana oyster. *Dermocystidium marimum*, a fungus disease which causes heavy losses in oyster areas of high salinities and high water temperatures, and "Thais" the oyster drill which is also the cause of heavy oyster mortalities in areas of high salinities.



JAMES N. McCONNELL

Both of these oyster enemies will be discussed in more detail by our Chief Oyster Biologist in his report attached hereto.

A brief outline of work program accomplished by our Biological Section is as follows:

- I. Introduction:
 - A. Nature of work program.
 - B. Outline of work.
- II. Description of Grand Terre area and new laboratory with photographs.
- III. Investigation of clam shells as cultch and results of Black Bay (Nigger Lake) planting.
- IV. Effects of food on oyster growth.
- V. Effects of fertilization of waters on oysters.
- VI. Comparison of growth and mortality of Louisiana and South Carolina oysters.
- VII. Studies of snail and oyster larvae abundance in plankton samples.
- VIII. Oily taste in oysters and effects of oil based mud.
- IX. Food preference of the Oyster Drill.
- X. Hydrographic picture of the area in relation to rainfall and river stages.
- XI. Sister Lake report.
- XII. Complaint reports and aid to oyster growers.
- XIII. Aid to private shell plantings.
- XIV. Cooperation with L.S.U. research.
- XV. Education groups and field trips.

Much has been accomplished by this group during the past two years in spite of the fact that they were seriously handicapped by lack of space in a makeshift temporary laboratory. Our new laboratory is now completed and laboratory personnel permanently settled in their new quarters. The total cost of this laboratory together with all modern equipment will be in excess of \$225,000.00.



Aerial photograph of the shell planting operation in Nigger Lake. Note the even coverage as shown by the silt from the shells behind the port side of the barge.

Shell Planting

The largest shell planting program ever undertaken in the South was completed in the early summer of 1959 when 135,369.18 bbls. of dead reef shells were planted in Lake Borgne approximately one mile Northwest of Petit Pass Island, 250,981 bbls. of clam shells were planted in Black Bay (Nigger Lake), and 8,667 bbls. of steamed oyster shells were planted in Bay Boudreaux surrounding Little Raccoon Island.

Lake Borgne Planting

The first inspection of this planting was made about the first week in August 1959. The result of this survey was most disappointing as we could not find any attached "set" at this time, although the shells were found to be clean and in excellent condition to receive "spat". We took water samples, and because of the heavy early summer rains and flood conditions prevailing in the Pearl River Basin realized that the salinity was too low for spat-fall. After this inspection and finding all the dead shells clean and in such splendid condition to receive "spat", we felt sure that when the September high tides arrived the salinity would rise and we could expect a good September, October and November set.

A second survey of this planting was made about November 15 and it was found that we had obtained a good set on about 80 percent of the shells examined. The catch averaged about 5 spat per shell with an average diameter of $\frac{1}{2}$ inch.

A third inspection of this planting was made during the second week of January and it was then found that approximately 90 percent of the shells had received a "set" averaging 8 spat to the shell with an average diameter of $\frac{3}{4}$ inch.

We obtained from this planting a much lighter catch than was obtained from the May, June and

July catch on the clam shells planted in Black Bay. However, at this time the comparatively light fall catch of spat on the Lake Borgne planting seems to be growing more rapidly than the heavy early summer spat catch on the clam shells in Black Bay.

A continual check will be made on these two plantings and it will be interesting to note what differences occur September 1960 when the first of these seed oysters will be moved.

Bay Boudreaux Shell Planting

During May and June 1959 the Mississippi cannery returned to the water bottoms of Louisiana as "cultch" 20 percent of shells from oysters canned by them during the 1958-1959 canning season, amounting to 8,667 bbls. These shells were planted under our direct supervision without cost to the State of Louisiana in a specially selected area in Bay Boudreaux completely surrounding Little Raccoon Island.

After two inspections, one in July 1959 and a second one during the first week in January 1960, it was found that we are receiving excellent results and that at this time the shells have received a 100 percent catch and are considerably larger than either of the other plantings. The shells planted here were clean steamed shells obtained from the canning plants' shell piles.

Black Bay (Nigger Lake) Planting

More than 250,981 bbls. of clam shells were planted at this location and an excellent set has been obtained. When the completion of a field survey showed such splendid results, the entire Black Bay was closed to all oyster operations until September 1, 1960, at which time a large catch of seed oysters is assured. The closed area in Black Bay has been well marked and a special patrol boat has been assigned to guard this closed section.

Coastal Waste Control

During 1959 an additional Coastal Waste Control boat, manned by a captain and a coastal waste control inspector was placed in operation to assist in controlling pollution of our coastal waters from rapidly increasing industrial activities. The Oysters, Water Bottoms and Seafoods Division has been assigned the duty of enforcing the rules and regulations set by the Louisiana Stream Control Commission. A more detailed report of the Coastal Waste Control Section of this Division will be made by the Chief Inspector of this Section and will be attached to this report.

A Commission plane has been stationed at Lake Charles and will assist in enforcing the Stream Control Commission Regulations from the Eastern end of the Atchafalaya Bay to the Texas state line.

Shrimp and other Seafoods

This Division is proud of the part it played in helping to formulate the Shrimp legislation of 1958, which in a large way was responsible for the increased shrimp production of 1958 and the even greater increase in production during 1959. After

the "shrimp bill" went into effect and became a law, the personnel of this Division assisted the Enforcement Division in the strict enforcement of this remedial legislation. The Seafood Section of this Division was placed under the supervision and direction of Percy Viosca, Jr., marine biologist with many years of experience in research connected with the Louisiana shrimp industry and other commercial marine fisheries, fresh water, commercial and sport fishes, crabs, frogs and crawfish. There are four boats together with their crews assigned to this operation as well as one other marine biologist and two biological aides. The work of this group consists of exploratory fishing gear development and use, statistical research, evaluation of fishery statistics, as well as certain informational services and educational work such as lectures, addresses and discussions before business clubs, high school and college groups, scientific societies, together with radio and television appearances. The purpose of all this is to acquaint the industry, the general public and the legislators with the facts pertaining to the seafood industries which have a bearing on their intelligent management.

Cooperation

This Division is indebted to Mr. Charles H. Lyles of the U.S. Fish and Wildlife Service and his statistical group for shrimp production figures which are the most accurate available. Due to the intense activity of this group we are now able to obtain more accurate shrimp production figures for all the coastal states than has ever been available before. To properly carry out fishery research it is absolutely necessary that we have such statistical information.

Crawfish Research

A crawfish program was inaugurated with funds appropriated through the efforts of Representative Robert Angelle in the fiscal session of 1959. A crawfish farm has been constructed and is presently in operation.

A much more detailed report of the activities of the Seafood Section of this Division will be made by Mr. Viosca and will be attached to and become part of this report.

SHRIMP PRODUCTION (HEADS ON)

Year	Bbls. (210 lbs. per bbl.)
1958	208,586.2
1959	254,437.8

FRESH WATER FISH PRODUCTION

1957	10,864,100 lbs.
1958	16,537,700 lbs.

SALT WATER FISH PRODUCTION

1957	20,934,200 lbs.
1958	34,664,400 lbs.

BABY GREEN TURTLES

1958	1,255,000
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MENHADEN PRODUCTION (UNITS)

(one unit = 666 lbs.—approx. 1000 fish)

1958	475,526
1959	818,918

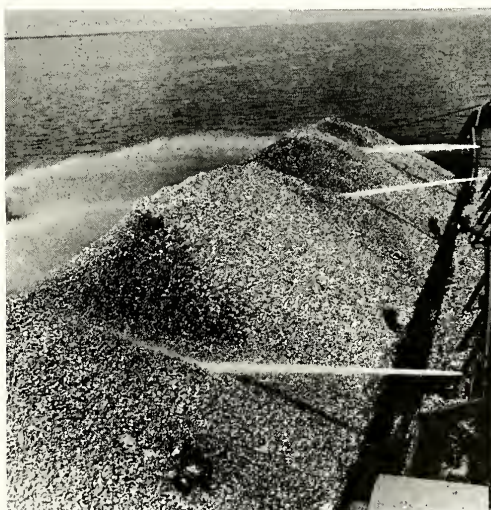
REPORT OF COLLECTIONS (FISCAL YEAR)

	1957-58	1958-59
Oyster Bedding Ground Rentals	\$ 44,313.00	\$ 52,141.00
Oyster Privilege Tax	13,008.83	12,917.21
Oyster Tonnage	1,536.50	1,273.50
Oyster Dredging	10,700.00	8,100.00
Oyster Resale, Shop, etc.	760.00	985.00
Transfer fees	27.00	35.00
Shells	637,481.71	736,467.56
Gravel	7,476.00	6,944.25
Sand and Fill Material	7,162.72	37,839.89
Survey fees	6,436.75	6,408.50

REPORT OF PRODUCTION (CALENDAR YEAR)

Total Barrels of Oysters Taken from Louisiana Waters

	1958	1959
Terrebonne	39,517.00	45,398.25
Lafourche	23,910.50	21,093.00
Plaquemines	138,807.50	199,467.50
Jefferson	57,110.00	50,944.50
St. Bernard	169,252.27	51,730.02



Close-up of the action of the pumps used in the Shell planting operation in Nigger Lake.

Total Cubic Yards of Sand, Shells and Gravel Taken from Louisiana Waters

	1958	1959
Sand	186,447.86	321,556.04
Oyster Shells	3,083,555.70	2,901,966.61
Clam Shells	3,814,645.04	4,032,026.20
Gravel	860.60	61,755.00
Fill Material	536,212.00	704,807.00

BIOLOGICAL SECTION

LYSLE S. ST. AMANT
Chief Biologist

A. V. FRIEDRICKS
Ass't Chief Biologist

JESSE L. ADAMS
Biologist

EMERY HAJDU
Biologist

ROBERT WALDRON*
Geologist

Introduction

The biological section functions as a technical service unit to the Oyster and Seafoods Division and to the Wild Life and Fisheries Commission on matters concerning marine problems, particularly those dealing with oysters, shrimp and other commercial species. Basically the program of the biological sections falls into several categories as follows.

1. Long range investigations: Aimed at bettering seafood production and quality and at alleviating various ills of the industry.

2. Short range studies and field examinations: Designed to furnish some immediate information which may be used by the Wild Life and Fisheries Commission in formulating rules, regulations, and policy concerning marine problems.

3. Direct technical aid to oyster growers: This is an extension type service offered the individual oyster grower. Upon official request, problems on individual oyster leases are studied and reported on.

4. Development and management: Natural state seed grounds and oyster reservations are studied and managed annually to achieve maximum production. Supplemental seed oyster production is accomplished by shell plantings.

5. Cooperative research: Cooperative research is carried on with the food technology laboratory at Louisiana State University and other university and governmental research agencies interested in marine problems.

6. Education: The biological staff and the facilities of the marine laboratory are available and are frequently engaged in various cooperative educational programs with the universities, colleges and high schools of Louisiana. Short courses, field trips and lectures are provided for interested parties upon official request.

*Resigned to seek private employment, November, 1959.



LYLE S. ST. AMANT

7. Water resources and pollution: Continual availability of maximum acreages of unpolluted estuarine areas are a necessity if Louisiana's seafood industry is to survive and increase. The technical staff makes studies, prepares reports and acts in matters of interagency coordination where estuarine problems are concerned. Much work has been done on the New Orleans to Gulf outlet, various ship channels and on projects to introduce river water into our excessively saline marsh areas. Studies of industrial pollution and specific pollution problems in oyster areas require approximately 30 percent of the work schedule of the present staff.

8. Other activities: Some time is spent in preparing papers and publications to be given at various meetings. The senior biologist is also active on various inter-state and national committees, some of which are (a) Shellfish research committee, Gulf States Marine Fisheries Compact, (b) Estuarine Committee, Gulf States Marine Fisheries Compact, (c) Pollution Committee, S. E. Section, American Fisheries Society.

In addition to the major parts of our program listed above much of this biennium has been occupied with the construction of first, temporary, then permanent marine laboratory facilities on Grand Terre Island near Grand Isle, Louisiana. The following report will detail typical examples of the work outlined above and will describe the location and extent of new laboratory facilities.

New Laboratory Facilities

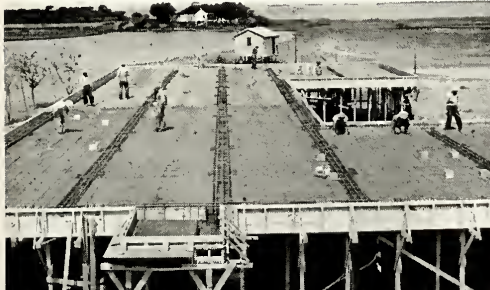
The need for a strong, continuing, long range marine research program cannot be over-emphasized. The marine fisheries industry in Louisiana is valued at nearly \$100,000,000.00 annually. In order to pro-



A view of the temporary laboratory buildings under construction at Grand Terre. These buildings had been crude camps on the barges in the foreground of this picture.

rect and further this valuable industry, research in and manage ment of our marine resources must be undertaken and maintained on a scale commensurate with the size and value of the industry. The heart of such a program must include an adequate number of well trained technical personnel, suitable equipment, a modern marine laboratory and headquarters and an adequate budget. The nucleus of such a program was initiated in the spring of 1955. Since then much progress has been made. Briefly the evolution of the present facilities has followed this chronological pattern.

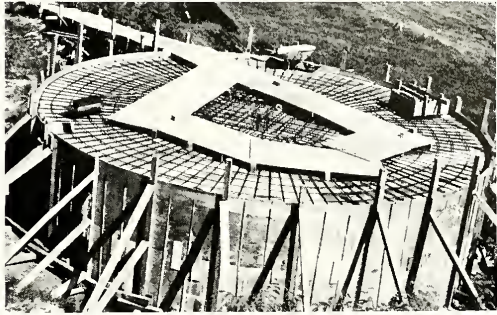
In 1955 all work was carried out by two marine biologists operating with a single boat and crew. In 1956 and 1957 a temporary field laboratory was set up on barges located in Barataria Bay and a second and larger boat was added. The biological staff was increased to three with additional aides. In November 1956 several locations were surveyed as possible sites for a permanent marine laboratory. Three locations in the vicinity of Grand Isle, Louisiana, seemed most promising and they were suggested to the Commission in a detailed report. After study, the Commission approved a 100 acre site on Grand Terre Island which had been deeded to the Louisiana Wild Life and Fisheries Commission by the Federal government. The biological section of the Oyster and Waterbottoms Division was directed to prepare plans and proceed with construction of a permanent marine laboratory and docking facilities. Plans for



The form for the concrete floor slab is completed and all of the reinforcing rods are put in place prior to pouring cement.

an entrance canal, turning basin, and dock were approved and this work was contracted and completed in 1957 (see seventh biennial report).

With the completion of the docking facilities and limited living quarters in Grand Terre Island, permanent headquarters for biological research and marine studies was established there in November 1957. During 1958 the research program was expanded to some extent but much time was spent in



This is the 46,000 gal. fresh water storage tank at the laboratory while under construction.

building and equipping a small temporary laboratory that could serve until a permanent laboratory facility could be constructed and equipped. Plans for the new building were completed and approved by the end of 1958 and construction was begun in March 1959. At the present time it is expected that the new laboratory will be completed, reasonably well equipped, and ready for use in February 1960.

In planning, constructing and equipping the new facilities every effort was made to design a unit that should adequately fulfill the needs for marine fisheries research for a twenty to thirty year period. Plans of other laboratories were studied, professional researchers from various universities were consulted, and the final plans were submitted to various experts for approval. The zoology, chemistry, bacteriology, and geology departments at Louisiana State University were particularly helpful. With the completion and occupancy of the laboratory it is believed that this accomplishment has been our greatest achievement during the biennium.

Investigation of Clam Shells As Oyster Cultch

The highly successful planting of reef shells in Black Bay (Nigger Lake) in 1956 established the



The laboratory framing is complete and the building begins to take shape.



A rear view of the outside of the nearly completed laboratory. The salt water storage tank on the right will permit a gravity flow of water for aquaria in the building. The large concrete tank to the left is for fresh water storage.

area as an excellent place to carry out large scale seed oyster production by means of shell plantings. Requests for larger plantings by the oyster growers resulted in an attempt to carry out a two-fold experiment during the early summer of 1959. For this investigation plans were made to plant an extensive amount of shells (260,000 bbls.) in the short planting season from May 1st through June 30th and to determine if clam shells which are normally smaller than oyster shells would serve efficiently as cultch.



Sixty-five foot piling were driven to support the laboratory building seventeen feet above mean low water, giving ample protection from storm tides.



Aerial view of the facilities of the Grand Terre Marine Laboratory. The temporary lab buildings are at the left of the boat dock and the new building under construction is the modern laboratory, which should be put in use shortly.

Method of Planting

The large scale planting of shells for oyster cultch is a critical operation requiring exactness and coordination of two factors. In the first place, the time of planting must be determined by studies of water temperature and examination of plankton samples. This time usually falls between May first and June 30th and covers a period of 60 days during which efficient spat catch can be expected in Louisiana waters. The exact starting date should be determined as accurately as possible because if shells are planted as much as two weeks too early growths of marine organism may form on the shells before oysters set and the results will be poor.

The actual beginning of the planting operation therefore may be as early as the last week in April in warm springs or as late as May 15 during long cold springs. The termination of the planting operation is controlled by the amount of oyster larvae in the water but in most cases the percent of set drops sharply after June 30th. The second critical factor is the spreading of shells over the planting area in an even and efficient manner. This is readily accomplished by washing the shells overboard from barges with high pressure water hoses. For efficient spraying of shells a minimum of 90 p.s.i. pressure on a 1 1/4 inch nozzle is required. Higher pressures and larger nozzle diameters are recommended for more rapid operations. In all cases for efficient operation the nozzles should be mounted in gimbles on stands fixed to the deck of the pump boat (see photographs 13-14 and diagram).

Since all planting must be completed in a 60 day period it is obvious that very large scale plantings require extensive planning and considerable amounts of heavy equipment. For example in planting 250,000 bbls. of shells in 1959 it was necessary to move and pump overboard over 100 large barge loads of shells. In this case a large pump boat (Navy L. S. T., see photos) with four high pressure pumps was necessary to unload at high speeds. Barges were emptied on an average of 40 minutes after pumping began. It is evident that still larger operations would require two or more pump boats, more barge handling and simultaneous operations in several areas.

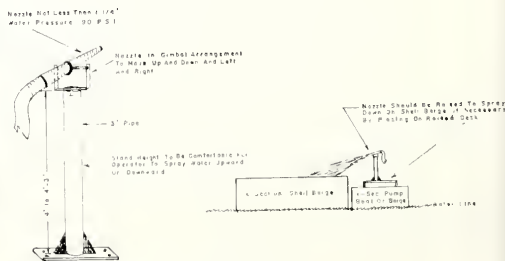


Diagram 1

Type of Bottom

In selecting an area to be planted suitable bottom should be located in an area generally known to produce successful spat falls every year. For small clam shells the bottom should be hard clay or old reef with little or no slush or fine overlying sediment. If larger oyster shells are used any mud and clay bottom capable of supporting the shell and at the same time allowing at least part of the shell to be supported above the bottom sediments will be suitable. Density of plantings should be held between 100 and 250 bbls. to the acre. Plantings during 1959 covered an area of approximately 1150 acres and the bottom consisted of hard clay and old reef. Underwater examination after planting indicated the shells to be well-spaced and well-exposed above bottom sediments.

Results and Conclusions

The final results of the 1959 shell planting cannot be determined until the summer of 1960. Initial sampling has indicated that the average set was extremely high and growth during the first two months was rapid. Samples of the first half of the planting indicated that 92% of all shells caught one or more spat. Samples taken over the entire area on August 30, 1959 indicated an average catch of 78%. Such high initial catches coupled with later setting in the fall and early spring should make this planting the most successful ever attained.

From examining oysters caught wild on clam shells, most oyster growers are of the opinion that better seed oysters are the result because fewer oysters set on the smaller area of the clam shell resulting in a better formed seed with less crowding. Because of this belief many oyster growers requested that clam shells be used for cultch in our planting experiments. The results obtained with clam shells do not bear this out, however. Clam shells planted properly at the peak setting catch just as heavily as do oyster shells and in some instances crowding of the set oysters is evident.

Preliminary Studies of the Effects of Food Abundance and Water Fertilization on Oyster Growth

It is well known that oysters of approximately the same age may not grow at the same rate. In some instances two oyster beds in slightly different locations but bedded with seed oysters from the same source may produce oysters of considerably different quality and yield. In some cases the cans per barrel yield from one site may be nearly double that of a near-by area. Studies carried on here also indicate that oyster spat of the same age and local source when grown under identical conditions in the same sea-rack will vary considerably in size. (See seventh biennial). It is evident that at least two and possibly more factors are involved in the rate of oyster growth. The obvious fact is that oysters of the same age receiving a more abundant supply and a better quality of food should have a greater average growth rate than oysters receiving less amounts or poorer quality food. This effect has been demonstrated for very young oysters by Dr. Loosanoff and

his group at the U. S. F&W Service Laboratory at Milford, Conn. It also seems probable that inherent metabolic characteristics or rate of feeding can cause oysters with identical food supplies to grow at different rates.

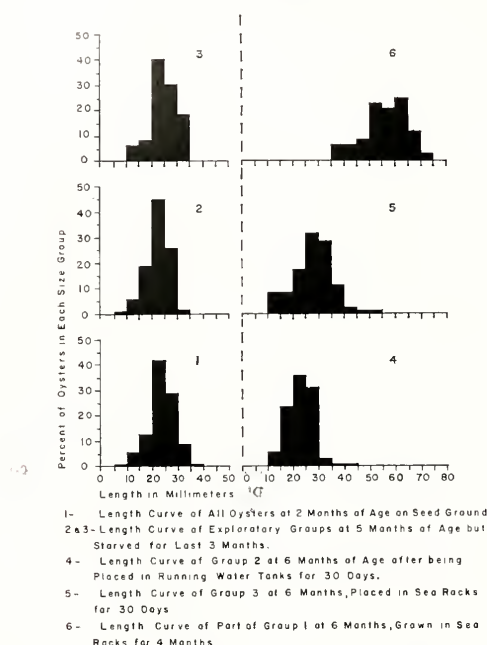
In these preliminary investigations an attempt has been made to find some practical application for this knowledge to Louisiana oyster waters. In early tests, reported here, a check of starvation conditions and abundant food supplies on growth rates were made on oysters of the same set from the age of two months to six months. Additional tests were made to determine if fertilization of sea water was practical and whether or not fertilized waters would increase the rate of growth. The preliminary studies were of a very simple nature designed mainly to establish trends and a basis for more extensive experiments.

Procedure and General Results

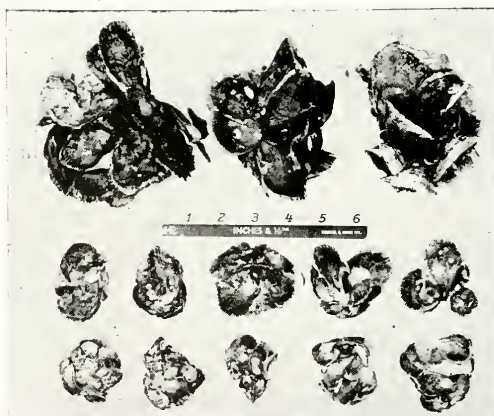
Common farm fertilizer of the 6-8-8 type (6-nitrogen, 8-phosphate, 8-potash) was added to filtered sea water in tanks at the rate of 0.5 to 1.0 gm. per gallon. These tanks were then inoculated with a mixed culture of phytoplankton. After 15 to 20 days a good bloom of phytoplankton occurred which consisted predominantly of *Chlorella* sp. All preliminary efforts have failed to result in a mixed phytoplankton culture or in a predominance of any type other than *Chlorella*. In all cases unfertilized but inoculated tanks were used as controls. After plankton blooms were established, 100 oyster spat two months of age were placed in each tank to determine, if possible, a differential in growth. Results were negative because all oysters in the fertilized tanks died very rapidly. The cause of mortality was not determined but it may have resulted from toxic substances in the fertilizer or produced by the heavy phytoplankton bloom. Loosanoff et al (verbal communication) have pointed out that some species of *Chlorella* are toxic and that old cultures of various types of phytoplankton may become toxic. It is interesting to note that in the tanks containing one gram of fertilizer per gallon of water the mortality rate was approximately twice as fast as that in tanks with 0.5 gms. per gallon.

Studies of growth in relation to food volume were simple and involved starvation conditions as compared to normal or abundant food supplies. Oysters two months of age and taken from recent shell plantings were placed in tanks without running water or other sources of food for a period of two months. Under such starvation conditions practically no growth occurred though mortality was nil. A second group of the same oysters was held in sea-racks in an area of favorable food supply to serve as a control. After three months of starvation group one was divided and half was put in running water tanks and half of the group was placed in sea-racks. This test was made to determine the relationship between the food supply in our tanks at a fixed rate of flow as compared to an unlimited food supply in sea-racks over a given period of time, in this case thirty days. The results indicate that the food supply in the running water system was sufficient to initiate growth after a period of starvation but was far less than that

Graph 1 - Variations of Growth Rate in Oysters of the Same Age as a Function of Food Volume.
(All Oysters Set in May 1959)



necessary to maintain the maximum growth rate that occurred under optimum conditions in sea-racks. A continuation of this study in detail particularly directed at determining practical methods for growing oysters faster is contemplated.



The results of various types of feeding are shown. The bottom row is from a group of young oysters starved for three months then fed in running water tanks for 30 days. The second row is from a group starved for three months but fed for 30 days in sea racks under optimum conditions. The top row is controls fed for five months in sea racks. All oysters were the same age and from the same set.

Oyster and Oyster Drill Setting Investigation

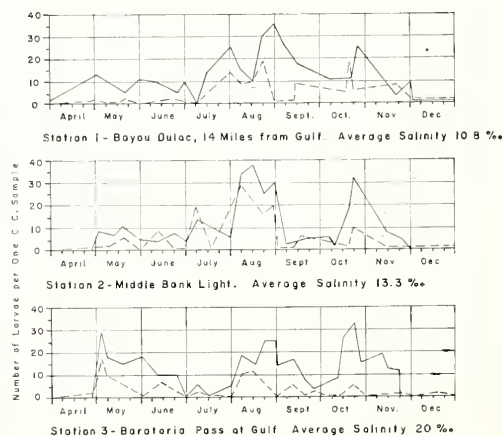
In June 1957, studies were initiated to determine the peak period of oyster and snail setting. Although

much work has been published concerning the setting of oysters and the factors controlling the population levels of oyster larvae in warm waters; it is apparent that for the information to be of practical value it must be determined for the specific area that seed oyster production is anticipated. It is also evident that conditions may change from year to year and a number of years work will be necessary before predictable patterns can be established. The purpose of these studies in Louisiana waters, aside from determining basic information about oyster biology, is a practical one aimed at determining the time of the peak setting periods in order that shell plantings for seed production can be made successfully and efficiently. All shell plantings thus far have been carried out during the months of May and June which is the generally expected peak of spring setting. It is believed, however, that if fall setting peaks are high enough shells planted at this time would produce a more useable and better quality seed by the following fall. Some of the initial work was reported in the seventh biennial and herein is reported a continuation of the work in 1958.

Methods and Results

After analysis of the data compiled it became apparent that the method used to collect and analyze the larvae population was not controlled well enough, nor were the collections made frequently enough to

Graph 2 -Density of Snail and Oyster Larvae in Plankton Samples
--- Snail — Oyster



furnish all of the information needed. For this reason the results here can only be considered as trends and only a representation of one year's setting picture as controlled in part by its peculiarities of weather and hydrography. The method used consisted of taking bi-weekly surface plankton samples at fixed stations ranging from near the Gulf to fourteen miles inland. Larvae counts were made of 1 cu. mm. samples from the catch at each station. The general results indicate that surface and bottom

samples should be taken with complete supporting data on hydrography, tides, wind direction and velocity and barometric pressure. More frequent sampling is desirable also if a reliable picture of oyster setting is to be determined.

Graph 2 illustrates the result of all sampling from April through December, 1958. Oyster setting peaks apparently occurred in two or three distinct periods. In the more saline areas of the lower bay an expected peak occurred in May and June. A second peak occurred in August and early September and a third in October and November. The occasion of a third setting peak in late fall as well as the apparent large size of both fall peaks was not expected. Certainly, findings, associated with shell planting experiments on the East side of the Mississippi river, indicate the spring set to be by far the greater. Observations in 1959 in the Barataria Bay area, however, gave further evidence that at least in 1958 and 1959 setting of oysters west of the river was not as good during spring as in the fall period. Whether this is an annual occurrence or the result of less than normal conditions during these years remains to be determined. (See hydrographic section)

Oyster setting at mid-bay and upper bay levels where salinities are lower indicate even less spring setting activity and higher fall peaks. One factor that casts doubt as to the reliability of the sampling is the fact that snail larvae population levels more or less parallel those of oyster larvae. Since the greater preponderance of evidence indicates that snails breed primarily in spring with a gradual decrease in breeding in summer until apparent cessation during the fall. It would seem that the snail population peak should be more or less single and should not occur later than midsummer. Not known is the average length of time that the snail larvae are free swimming. A long period of free swimming with an accumulation of individuals toward the end of summer would tend to confuse the data analysis.

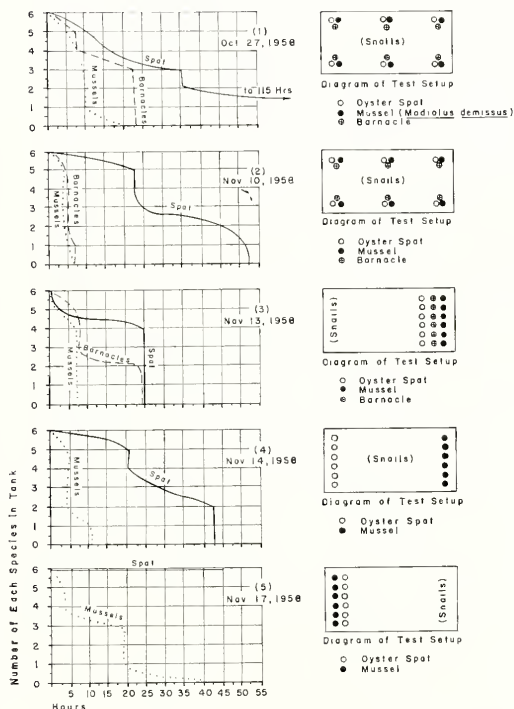
In conclusion it is evident that fall settings of oysters in sufficient numbers to make shell plantings practical is a distinct possibility. More detail studies are being taken to clarify our present knowledge of oyster setting in Louisiana.

Investigation of Food Preferences of the Louisiana Oyster Drill

In the seventh biennial report (1956-57) it was pointed out that findings of Butler (1953) and of this writer in 1937, 1956, and 1957 indicated that the Southern oyster drill *Thais* had distinct preferences of food and that the oyster was not the preferred diet. Butler (1953) reported an order of preference as follows: mussels, oyster spat, barnacles, clams, hydroids, and finally large oysters. This writer's observations supported this order of preference. In these investigations tests were designed to determine the relative extent of preference for mussels, oyster spat and barnacles by *Thais*. In all cases 29 snails were starved for a short period then placed in a tank with food choices of oyster spat, mussels (*Modiolus demissus*) and barnacles arranged in various patterns around the group of

snails. Observations were made to determine which food the snails sought out first, whether they by passed one type in preference for another, and the time element involved until all foods were eaten. The same 29 snails were used in all tests and they ranged in size from 15 mm. to 61.5 mm. Small oyster spat from 25 to 33 mm. in size were used in all tests because they are much more readily attacked by snails than are larger oysters. Mussels were in the same size range as the oyster spats while the barnacles averaged between 17 and 23 mm.

Graph 3 - Food Preference of the Gulf Oyster Drill



Graph 3 with the inset diagram of the various tests show how each test was made and the results of each test. The graphs show the rate of feeding, the preferred food and the total length of time required to consume each food. It is evident from all tests that mussels are by far the preferred food of the three choices and oysters least preferred. Snails would by-pass or climb over oyster spat and barnacles to eat the mussels first. Contrary to previous observations by Butler and the writer, barnacles proved to be the second choice of food in these tests rather than oyster spat. This may have been the result of the test design or the size of the oysters used, however, there is a distinct possibility that barnacles are preferred to oysters. The comparative rate of consumption shows mussels to be eaten at the rate of approximately 0.5 per snail day and oysters to be consumed at the rate of 0.1 per snail day. In these calculations the November 17th test was omitted because cold weather interrupted the feeding on oysters.

South Carolina Oysters

The staff of this laboratory has been trying to develop an oyster that is resistant to the fungus infection, *Dermocystidium marinum*, Owen, Mackin and Collier, which is believed to be the cause of heavy mortalities in Louisiana oysters in recent years. This disease has been blamed for the death of almost all two-year old oysters in the higher saline waters along the coast during the hot dry summer months. Consequently, no oysters can be held for longer than 6 months in the best oyster fattening areas of the Louisiana coast because of these summer mortalities. For this reason the quality and production of the Louisiana oyster has dropped considerably since the early 1940's when this disease reached epidemic proportions. In order to improve the quality and production of Louisiana oysters an effective means of control for *Dermocystidium* should be developed.

In an attempt to accomplish this aim, this section of the Louisiana Wild Life and Fisheries Commission began experiments to develop an oyster that is disease resistant, similar to feats accomplished by agronomists in wheat rust, corn diseases, etc. If a resistant strain of oysters can be developed, it should be possible to introduce it into the oyster industry since oyster culture as carried on in Louisiana is actually a farming process, raising a crop on the bottom of the coastal bays.

Mr. G. Robert Lunz, Director of the Bears Bluff Laboratory, Wadmalaw Island, South Carolina, had suggested in verbal communications with the senior biologist that oysters in S. C. were resistant to *Dermocystidium*. It was on this basis that personnel from this laboratory obtained approximately 6000

oysters from South Carolina in December 1958. These oysters were from cultch that Mr. Lunz had placed in Wee Creek, S. C., on August 8, 1958, and held at this location until December 8, 1958, at which time they were transported to Louisiana and placed in baskets at the Grand Terre Laboratory.

As compared to Louisiana oysters, the native oysters in South Carolina waters grow very slowly. It takes three to five years to raise a market oyster in that area, whereas most oysters marketed from Louisiana waters are less than two years old. In order to determine the relationship between the oysters and their habitat, a concentrated study of the growth and mortality rates of South Carolina and native oysters of the same age was carried out. One hundred oysters from each area were put in a basket at this laboratory and periodically their length and volume were measured. Mortality was also checked.

Results

Graph 4 illustrates the growth rate of these oysters. In this illustration the base line of each graph falls on each date. The rate of growth is depicted by the number of oysters in each size range and is indicated by the curve to the right of each base line.

At the beginning of the experiment, the Louisiana oysters averaged 50 mm. in length and the South Carolina oysters of the same approximate age averaged 38 mm. From this size variation the growth patterns increase in a parallel manner at approximately the same rate, until in October the S. C. oysters average 70.8 mm. and the Louisiana oysters averaged 78.8 mm. All of the native oysters had reached 50 mm. by August; the South Carolina oysters reached this size in October.

GRAPH 4 - GROWTH PATTERNS OF NATIVE AND SOUTH CAROLINA OYSTERS IN LOUISIANA

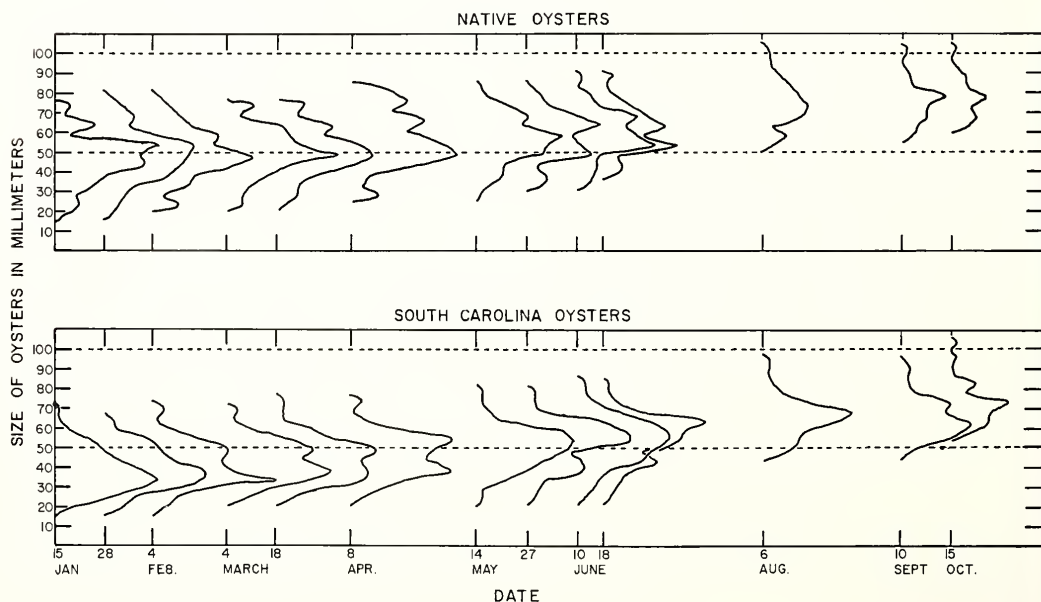
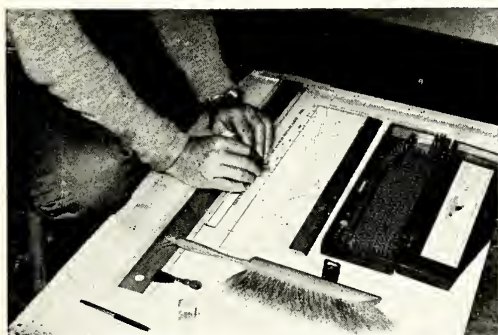


Table 1
AVERAGE MEASUREMENTS OF NATIVE
AND SOUTH CAROLINA OYSTERS
IN LOUISIANA

Date	Average Length		Average Volume		Vol.-Length Ratio	
	S. C.	La.	S. C.	La.	S. C.	La.
1-28	38.0	50.0	5.5	9.0	.144	.180
2-11	36.6*	50.8	5.6	9.4	.153	.185
3-4	38.0	52.5	7.2	11.2	.189	.213
3-18	45.7	52.3	8.4	12.5	.183	.239
4-8	47.2	55.0	11.0	14.6	.233	.265
5-14	51.6	52.9	12.3	18.4	.238	.347
5-27	54.1	54.6	14.3	21.2	.264	.388
6-10	56.8	60.4	17.4	24.4	.306	.403
6-23	58.1	60.4	18.0	24.9	.309	.396
8-6	67.6	73.5	25.6	37.8	.378	.514
9-10	66.7	76.0	27.9	44.6	.418	.586
10-15	70.6	78.8	36.6	51.0	.509	.647

*Four oysters died and since the experiment was just beginning four oysters of approximately the same size were added.

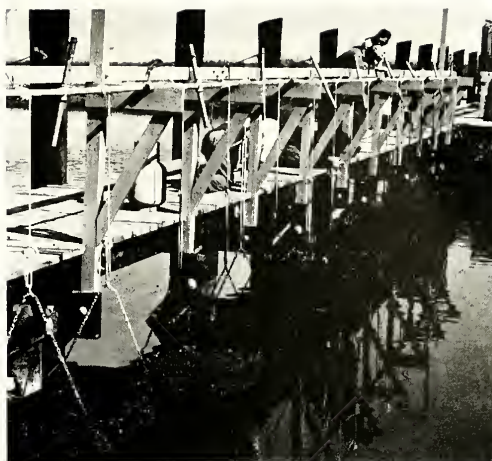
Since all oysters do not grow in the same size and shape, it was decided to determine if there was a



The new Marine Laboratory is equipped with all the necessary equipment for scientific work. Pictured above is one of the staff shown making a final draft of a graph which appears elsewhere in this report.

variation in the relationship between the length and volume. This was attempted by means of a direct ratio between the volume and the length. This ratio does not show any difference between the two kinds of oysters used but does show a growth characteristic that has been observed previously in Louisiana oysters at this laboratory. At the beginning of the growing season the oysters exhibited rapid growth in length and then the lengthening process slowed and the oysters thickened and increased in volume very rapidly. This shift in growth pattern occurred during June as shown in table one, above. The volume-length ratio increases slowly until June, then it increases rapidly until October. Further work is needed to determine whether this shift is due to environment or age of the oyster.

The mortality in South Carolina oysters during this period was 50 percent and 60 percent in the Louisiana oysters. Whether this slight difference is



The system of cranks and baskets shown here for holding oysters has evolved from many methods tried at this laboratory.

significant cannot be determined without further study. However, Table 2 shows most of the deaths in the South Carolina group occurred in August, September, and October, which is a typical *D. maritimum* mortality picture. The Louisiana oysters died in two peaks, one in May and June and one in August and September. This would indicate possibly that the Louisiana oysters died from two causes, one probably being *D. maritimum*. Checks to determine the percent of oysters infected with this disease were inconclusive. These data indicate further detail studies are necessary to determine the causes of these mortalities.

Table 2
MORTALITY RATE OF NATIVE AND SOUTH
CAROLINA OYSTERS IN LOUISIANA

Date	S.C.	La.
January 28	4	0
February 11	1	2
March 4	0	1
March 18	0	1
April 8	0	3
May 14	5	13
May 27	0	8
June 10	2	7
June 23	0	2
August 6	13	14
September 10	8	6
October 15	17	3

A similar experiment was attempted in low salinity waters, since conversation with Mr. Lunz revealed that apparently higher salinities occur in South Carolina oyster producing areas than occur in oyster producing areas of Louisiana. Oysters from each group were placed in a pond on Grand Terre Island and checked as above. These oysters did not exhibit the rapid growth characterized by those put in highly saline water and all of these oysters died in June when temperatures rose and salinities

dropped to 5 parts per thousand. The Louisiana oysters apparently withstood lower salinities better since they did not show high mortality until this very low salinity was reached, but the South Carolina oysters began dying when the salinity reached 9.6 parts per thousand in April. There were not enough oysters used in the test to make a statistically sound observation, but indications point to a higher toleration of low salinities by the Louisiana oysters.

At the present time this work is only in its preliminary stages. Much more data is necessary to determine whether South Carolina oysters are disease resistant and whether they can be successfully used as breeding stock. There is the possibility that oysters that are disease resistant may be found in some isolated areas of Louisiana. This search is in progress. It is essential that some means of controlling this disease be devised so that second summer oysters can be held in the high salinity areas along the coast if the industry in Louisiana is to improve the production and quality of its oysters.

Biological Services to Individual Oyster Growers

The growing of oysters as a money crop involves many problems. Aside from the normal vagrancies of weather, hydrographic variables, and variations in production that can be expected, the oyster grower must contend with losses from diseases, predators, pollution, and the general effects of industrial expansion in his growing area.

The oyster grower's need for technical advice is manifold. Like a land farmer, he looks to the State and Federal governments for such aid. In order to meet this need the biological section of the Oyster Division, Louisiana Wild Life and Fisheries Commission furnishes general technical aid to the oyster industry as a whole but supplements it to a considerable extent by an extension type service to the individual oyster grower. This latter service is in great demand and usually involves studies on private leases when losses or damages occur for any one of



One of the biologists is shown bringing back samples of oysters that have been badly silted by industrial dredging operations. Examinations of private leases in cases such as this take up about 35 percent of the time of the staff at the Marine Laboratory.

many reasons. In addition, the biological staff also advises and aids in private shell planting operations designed for seed production. During 1959, two such plantings were supervised and it is believed that the demand for this service will expand.

The results of the examination of damages to private leases reflect rather clearly the types and extent of the various problems resulting from industrial expansion into oyster growing areas. A comparison of the types and number of cases from one biennium to the next reflects the results of the State's pollution control system as well as the effects of education of industrial operators as to what constitutes good pollution and damage abatement practices.

Table 3 compares the summaries of all types of complaints and examinations during the last two biennia.

Table 3
TYPES OF COMPLAINTS

Cause of damages	1956-57		1958-59	
	No.	%	No.	%
Seismic operations.....	8	13.3	2	4.5
Silting and dredging.....	25	41.6	25	56.8
Oily taste in oysters.....	9	15.0	6	13.6
Ecological changes.....	4	6.6	3	6.8
Examinations prior to dredging	5	8.3	1	2.3
Marsh buggy damage.....	3	4.0	1	2.3
Oyster diseases.....	1	1.7	.....	.....
Unknown causes.....	5	8.3	1	2.3
No damage found.....	0	0.0	2	4.5
Tug and barge damage....	0	0.0	3	6.8
Totals	60	99.8	42	99.9

It is evident from the above table that there has been a decline in the number of cases involving damage or alleged damage by industrial operations. The drop from 60 to 42 cases reflects a 30 percent decrease in such problems between 1956 and 1960. On the other hand, the percent of each type of damage has changed very little. Dredging and silting coupled with pollution from oil (oily taste) makes up nearly 70 percent of all complaints. It is also important to note that these particular types of cases have declined very little between the two biennial periods.

In conclusion, it should be pointed out that the total amount of pollution and damage is extremely small when the great amount of industrial operation in the coastal area is considered. It reflects the good faith and cooperation of industry in controlling pollution to a minimum as well as the efficient functioning of the State's pollution laws and enforcement agency. On the other hand, it is our experience that the damages which have occurred are a result of carelessness or claimed ignorance of the rules by occasional operators, many of which are contract units and not under the complete control of the major companies. It is our opinion that there is no excuse for such flouting of laws and we would strongly recommend that companies employing contract drilling and dredging services impress upon

these services the need for complying with pollution prevention and abatement rules.

An Analysis of Oyster Production in Sister Lake

Sister Lake (Caillou Lake) located in Terrebonne Parish was set aside as a seed oyster reservation in 1940. The history of its production of seed oysters has been varied, but since 1951 production has declined gradually for many reasons; the principal ones being marked ecological changes involving increased salinities. (See Biennial Reports Nos. 6 and 7). Intensive studies have been made of the production and conditions of the lake since 1955 and data from these studies coupled with data available since 1950 present what we believe to be a reliable picture of oyster production from the area. Those factors controlling production also are becoming more clear as the studies continue.

When this 8000 acre lake was set aside in 1940, ecological and hydrographic conditions were optimum for seed oysters. Apparently production was good until 1950 and in addition it was supplemented with shell plantings. During the late 1940's and early 1950's a dry weather cycle, coupled with the damming of certain bayous and the extension of the lower Atchafalaya River levees, served to lower the amount of fresh water entering the lake, which resulted in a marked rise in salinity. Salinities prior to 1952 were below 15 parts per mille enough months of the year to prevent invasion by oyster drills or disease. Subsequent to 1952 salinities gradually rose to above 20 parts per mille during many months of the year and the invasion of most of the 8000 acre lake by the oyster drill *Thais* destroyed all seed oyster production except for a 600 acre area in the northern part of the lake near Grand Pass. Since 1957 heavy rainfalls have again lowered salinities to more optimum levels and production has increased. Since only one dredging of the lake has been allowed since then it is not yet clear whether increased production is resulting from this change

in salinity.

All of the studies reported on here were confined to the 600 acre area that has continued to produce. Old rotten shells in the remainder of the lake produce few seed oysters and these are soon consumed by snails.

Comparison of Size, Density, and Production of Oysters from Sister Lake 1956-1959

Records of production from Sister Lake seed oyster reservation indicate that the last major production occurred in the fall and winter of 1953-1954 when 90,000 bbls. were produced. This relatively high figure occurred after two shell plantings were carried out in June and July of 1952 and 1953. It is also true that some of this production came from the major body of the lake where snails prevented oyster growth after 1954. Since that time all production has come from 600 acres in the north end of the lake and no supplementary shell plantings were made because adequate shells occur in the area. Production subsequent to 1954 gradually declined to a low point of 4,500 bbls. (not harvested, only estimated) then rose to 15,000 bbls. in the winter of 1958, which was the last dredging season. Investigations made in the lake in August 1959 indicate that the population is still increasing, with an estimated population of 25,000 to 30,000 bbls. of market oysters ready for harvest at any time. (See Table 4)

An examination of the summary data in table 4 indicates several important points. In the first place, the controlling factor in production is the number of market-sized (2-4 in.) oysters per bushel of sample. For example, in 1956 while the total density was only 129 oysters per bushel, 80 of these were market-sized and the actual production from the lake was some 20,000 bbls. In 1957 while the total density of oysters increased to 164 the number of market-sized oysters decreased to 40 per bushel and the production of the lake fell to approximately 11,000 bbls. On the other hand, high

Table 4

VARIATIONS IN TOTAL MARKET AND NON-MARKET OYSTER PRODUCTION, SISTER LAKE 1953-1959

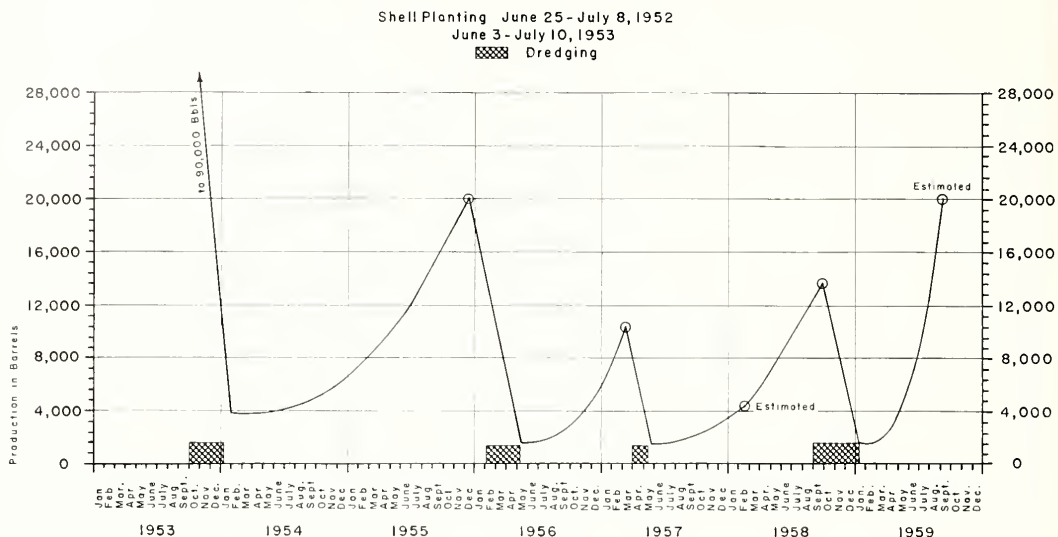
Year	Month	Total sample in bushels	Total oysters	Total oysters per bu.	Total non-market oysters-bu.	Non-market oysters bu.	Total Market oysters	Market oysters per bu.	Production of Lake in bbls.
1953-54	Sept.-Jan.	No records of oyster sizes, shell planting 1952-53							90,000 bbls.
1956	Feb.-March	9.0*	1161	129	446	50	715***	80	20,000 bbls.
1957	Mar.-May	7.0*	1166	164	880	125	286	40	11,000 bbls.
1958	Feb.	9.2*	2426	265	2189	238	327	25	4,500 bbls.*
1958-59	Sept.-Jan.	7.1*	1106	254	1120	171	586	83	15,000 bbls.
1959	Aug.	6.9*	1803	261	765	110	1038	150	25,000 bbls.

*All calculations from total catch in bushels including live oysters and dead shells. Samples are from the same stations each year.

**Population estimated but not harvested.

***Market oysters are 2-4 inches and larger suitable for both seed oysters and canning.

Graph 5- Oyster Production, Frequency, and Duration of Dredging, Sister Lake 1953-1959



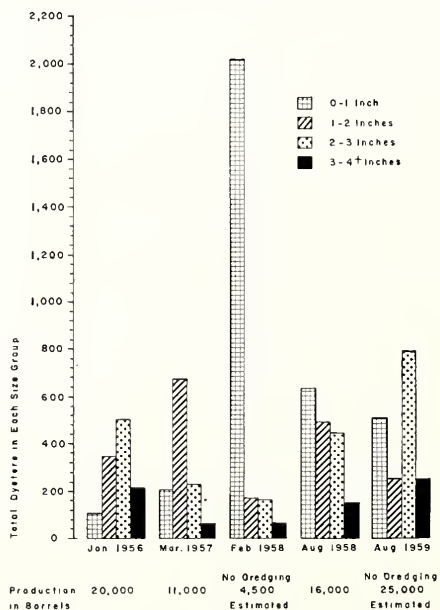
densities of small oysters per bushel indicates a good set for the year and probably an increase in production 18 months later.

Graph 5 shows production and the effects of frequency and duration of dredging in Sister Lake from 1953-1959. The saw-toothed effect is the result of estimating the actual recovery and growth between dredging or sampling periods. It seems evident that dredging on alternate years (every 24 months) gives better population recovery and more time for growth; the exception being from August 1958 to August 1959 when exceptional recovery occurred in one year. The lake was kept closed to dredging at this time, however, and it is expected that production in the fall of 1960 will be the highest since 1953. The length of time that dredging is allowed in any one season appears to have little effect and probably operates according to the law of diminishing returns.

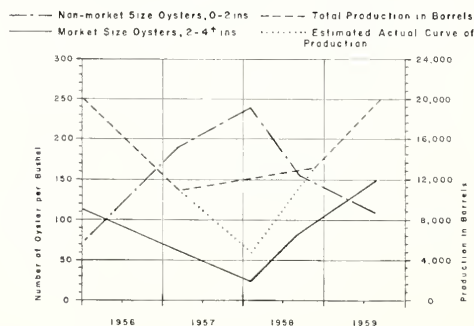
Graph 6 and 7 indicate even more clearly the relationship between oyster size and total production. In Graph 6 it is seen that as the number of large oysters per bushel declined the production went

downward accordingly and as the curve ascended so does production. Graph 7 showing the total number of oysters in each size group from all samples indicates both the success of setting and survival to market size. The last two columns in each graph represents market-sized oysters and the area in these two columns when compared from year to year is indicative of the amount of production to be expected.

Graph 7- Total Number of Oysters in Various Size Groups From All Stations



Graph 6- Relationship Between the Number of Market and Non-market Oysters per Bushel and Production in Sister Lake



Conclusion

Studies of Sister Lake have provided much basic information concerning natural production on seed oyster grounds. It also strongly indicates that for seed grounds to reach maximum production they should be harvested every other year. Such a plan has been proposed for Sister Lake and continued annual investigations will determine if this is the best course of management on all seed areas.

Drilling Muds and Obnoxious Taste in Oysters

In 1955 nearly 40 percent of all complaints of damages or changes on private oyster leases involved oily taste or a combination of oily, soapy, bitter or other than normal taste of the oysters involved. The results of studies carried out at the marine laboratory of the Louisiana Wild Life and Fisheries Commission indicated that the basic cause of oil taste was the contamination of leases with oil emulsion based drilling muds which had been lost over board in oil drilling operations. (See 7th Biennial Report, 1956-57). This discovery cleared up many discrepancies in previous complaints involving oily taste in oysters when such cases could not be correlated with definite losses of oil from wells, tank batteries, or pipelines.

With the discovery that oil based drilling muds or similar materials could cause oily taste and did violate Stream Control Commission regulations when discharged into state waters, oil companies were notified to cease such practices. With good co-operation from most companies and efficient enforcement, the number of complaints involving oil taste dropped from 40 percent in 1955 to 15 percent in 1957 and to 13% by 1959. Though further decreases in this type of contamination is hoped for, it should be pointed out that the largest number of cases still occurring in 1959 are the result of either accidents or individual carelessness, both of which leave little possibility of complete prevention of such pollution.

Since the original discovery of the effect of oil based muds on oysters, many tests and experiments have been made at this laboratory aimed at determining all of the ramifications of the effects of such compounds on oysters. The results and details of these tests will be prepared for special publication when all of the data is analyzed. In addition will be studies of the taste and toxic effects of related types of drill bit and stem lubricants on oysters. The principal findings involving oil taste in oysters as a result of contamination with oil based drilling muds are published in the 7th Biennial Report, 1956-57.

Some Hydrographic Characteristics of Barataria Bay as Observed From 1956-1959

The salinity gradient, temperatures, water movements and the factors controlling these characteristics of a body of water can be of considerable importance to its seafood production. Ideally such data should be collected continuously or at least daily from as many strategically located stations in an area as possible. Such a task requires considerable

equipment and manpower. Over the past four years the technical section of the Seafood Division has gradually increased its ability to gather more and more such data; however, it is still unable to do a completely satisfactory job over much of the coast. The data from Barataria Bay, however, is of sufficient completeness to show some hydrographic trends that can be used in an overall understanding of oyster conditions and production.

Basically, Barataria Bay receives its salt water from the gulf via Four Bayou Pass, Pass a Bel, and Barataria Pass. Tidal currents tend to circulate the salty gulf water in the lower part of the bay with a gradual movement of tongues of salt water into the upper part of the bay. In time, mixing in the entire bay is complete. Fresh water enters the area from Bayou St. Denis, Bayou Dulac, Wilkinson Canal, and to the west from the Lake Salvador-Little Lake area. Much of the circulation and mixing of salt and fresh water is controlled by prevailing winds. Normally fresh to strong south to southeasterly prevailing winds in late spring, summer, and early fall tend to move salt water into the bay and well up into its upper reaches. Tides at such times are above normal. In winter, northerly winds, accompanying periodic cold fronts which pass through the area, tend to lower tides and prevent the movement of gulf waters into the upper ends of the bay. Fresh water from the upper reaches moves further gulfward and salinities in the bay are lowered. As a front passes through the area, however, winds may be strong southeasterly before the front arrives, switching rapidly to northerly as it passes. This can cause rapid changes in water movements and salinities during the winter months.

Daily and local area salinities in Barataria Bay fluctuate so frequently that a considerable mass of data must be available for analysis before the mean conditions in a given area can be determined for any length of time. The data gathered here, for example, shows that the year 1956 was generally a period of high salinities in Barataria Bay. Mean salinities in the lower bay region ranged from 24 to 29 percent in the spring, summer and fall and only dropping in late winter to 18 percent. On the other hand, in 1957 from January through August there was a mean salinity that averaged 18 percent for all months. This can be considered a marked change in salinity for a considerable period of time. Furthermore, for considerable periods of time in April, May, and June of 1957, salinities at Four Bayou Pass were as low as 12 percent. This extreme drop in salinity in the lower bay region had a marked effect on the breeding and feeding activities of the oyster drill *Thais*. Reproduction was much reduced and most of the adult snails became inactive or died. On the other hand, oyster set in Barataria Bay was the most successful in several years.

In attempting to determine the factors which caused these changes both area rainfall and Mississippi River stages were analyzed and correlated with conditions in Barataria Bay for the two year period. The average rainfall from 1956-1959, for the six month period April to September each year, ranged from 37.3 to 43.1 inches. Between 1956 and 1957 there was a four inch differential, with 1957

having the heavier rainfall. This could have had some bearing on the lower salinities during that period. On the other hand, 1958 had a spring and summer rainfall of 38.6 inches, about equal to 1956, but lower than 1957, yet mean salinities in 1958 continued in the low range similar to 1957. This would tend to indicate that normal fluctuations in local rainfall only have a short term effect on salinity, while over longer periods rainfall effects tend to average out. If such is the case only extreme droughts or excessive rains locally over an extended period of time can be expected to make a significant change in the annual mean salinity. Much more significant appears to be the correlation between the Mississippi River stages and the mean salinities over longer periods of time. During 1954, 1955, and 1956 low river stages during May, June, and July correlated well with higher mean salinities in the bays west of the river as far as Barataria Bay. In 1957 high river stages during the spring and summer were associated with low salinities as far west as Grand Isle. River water was observed largely unmixed with sea water at Four Bayou Pass and salinities for several weeks were extremely low for the area (12 to 14 percent). Prevailing southeasterly winds eventually mixed the river water and bay water, generally lowering salinities over all of Barataria Bay. In 1958 the same pattern was repeated to a lesser degree.

Water temperatures influence movements of various species into and out of the shallow coastal waters and controls to a large extent the breeding seasons of the various cold-blooded animals. Our experience indicates that 20° C. (70° F.) is the temperature above which most breeding activity occurs. Continuous temperature recordings taken in lower Barataria Bay indicate that water temperatures usually rise above the 20° C. mark in the last two weeks in April and continue above this temperature through the summer and fall, dropping below this point again in November. Variations from this pattern may occur and such variations result in noticeable changes in what might be considered normal animal activity in the area. For example, during unusually mild winters bay waters will warm up above 20° C. for short periods of time during which some breeding of oysters, snails, and other forms are observed. During such mild periods the spring will be warmer and the water temperature

will rise above the critical temperature earlier in April. Accompanying such a rise in temperature, breeding, feeding, and movements of all animals in the bay are advanced several weeks. Conversely, cold winters and springs delay activity for several weeks. As an example, in 1958 and 1959 water temperatures in April were below normal and shrimp were several weeks late in moving from the gulf to inside waters. The peak of breeding activity of the snail *Thais* and of oysters was delayed considerably.

Cooperative Research and Education

Since 1955 the technical staff of the marine laboratory has actively cooperated in research on oysters and shrimp with the Biochemical and Food Technology sections of the Louisiana State University Chemistry Department. This research being done by Dr. E. A. Fieger and his associates has produced considerable valuable information concerning the basic chemistry, food value, and preservation of oysters and shrimp. As a result of this cooperative effort, a joint paper concerning the chemical composition of oysters at different times of the year and from different locations has been published in the 1958 *Annual of Seafood Merchandizing*. This laboratory has also furnished oyster samples for vitamin analysis which has resulted in a publication by Dr. A. F. Novak.

In addition to the work on oysters the facilities of the marine laboratory have been made available for many experiments on the preserving of shrimp by Dr. Fieger and Dr. Novak. It is hoped that this work will continue on a much expanded basis with the completion of the new laboratory facilities.

Other cooperative efforts by the technical staff with the facilities of the marine laboratory have been aimed at enhancing the educational program of the State in the field of marine biology and fisheries conservation. Frequent field trips, collecting trips, lectures and demonstrations have been made at the laboratory headquarters for college and high school groups. Some of the Universities and schools taking advantage of this service upon official request have included Louisiana State University, Louisiana State University at New Orleans, Tulane University, Southeastern College, North East Center, Centenary College, Baton Rouge High School, Golden Meadow High School and others.

SEAFOOD SECTION

PERCY VIOSCA, JR.
Marine Biologist

Summary of Activities

The activities of this section are concerned primarily with the species involved in the commercial fisheries, the nature of their environments, and the changes in these environments brought about by both natural and man-made factors. Included are such diverse fields as ecological investigations, population sampling, exploratory fishing, gear development and use, statistical research, evaluation of fishery statistics, as well as informational services and educational work as pertains to these phases of the commission's activities. Incidental to these types of research are certain necessary administrative duties.

Educational and informational services are conducted in cooperation with the Education & Publicity Division. They consist of lectures, addresses and discussions before business clubs, school and college groups, scientific societies, and various organizations representing the industries involved. There are also radio and television addresses. Much material of value to the industry is published and distributed to various organizations, schools, and other interested bodies and persons. Our purpose is to acquaint the industry, the general public and the legislators with facts pertaining to the seafood industries which have a bearing on their intelligent conservation and management.

Your biologist is in close touch with similar work in other areas through his activities in connection with the Gulf States Marine Fisheries Commission, the American Fisheries Society and its Southern Division, and other outside co-operating agencies. Not only our own data, but pertinent information gathered by other sections of this commission, as well as by outside co-operating agencies, is evaluated in its relation to the overall research program of this section. To be of value, all of these diverse types of information must be properly integrated and applied for the benefit of the fisheries.

Shrimp Studies

Stimulus to intensified research on shrimp was provided by the dwindling supply of the white species, *Penaeus setiferus*, which reached the lowest level of recent years during 1957, when the harvest was about 10% of normal. Recovery began in 1958.

After an analysis of the many factors which have been blamed for the decline of the white shrimp population, it would seem that only two merit serious consideration: the effect of the extended drouth in the Mississippi River drainage area on the shrimp nursery grounds; and over-fishing, which could conceivably have upset the balance of nature to the disadvantage of that species.

The drouth first became evident in the fall of

1952 and continued until the spring of 1957, causing prolonged salt water intrusions which drastically changed ecological conditions in inside waters normally inhabited by juvenile shrimp. After the rains began to fall in early 1957, they continued almost unabated until the present time. Thus, three successive years have elapsed since the breaking of the drouth.

The white shrimp peak harvest of 1953-54 lagged some three years behind the peak of a wet-weather period extending from 1949 into 1952. A serious white shrimp decline became evident in 1956, nearly two years after the midway-point of the 1952-57 drouth; and the lowest point in white shrimp production occurred in 1957, nearly three years after the middle of the drouth. This low point actually occurred after the drouth was broken.

During the 1952-57 low water period, the water shortage in the combined flows of the Mississippi-Atchafalaya outlets averaged 186,806 cubic feet per second below the mean of 648,519 cubic feet per second for the past 44 years. The greatest previous shortage was during the all-time low water period of 1930-31, when the annual deficiency was even greater, and averaged 218,747 cubic feet per second below the 44-year mean. This earlier deficiency, however, was for a two year period, whereas the more recent general drouth lasted four years. As a result, the total deficiency of water-flow into the northern Gulf through the Mississippi-Atchafalaya outlets during the more recent drouth was nearly twice the magnitude of the total deficiency during the all-time low water period of 1930-31.

After the 1930-31 drouth, shrimp production (which was practically all white shrimp) reached a low level in 1932, which lasted through 1933. Gross production during the period was virtually independent of the number of operating units. Although the number of trawls increased by 43 percent in 1933 over 1932, gross production increased only by 10 percent. Still earlier, shrimp production began to rise after the all-time flood of 1927 without an increase in the number of operating units. It reached a peak during 1929, and during the following year, 1930, 21 percent less boats harvested only 6 percent less shrimp.

An analysis of the data seems to indicate that a lag of two years or more may occur between the high and low points of the river-flow curves and the correlated high and low points in white shrimp production. In other similar periods, the data is confused by complicating factors. An example was the opening of new fishing grounds in outside waters by Florida-type boats with their larger gear in 1940.

The new Louisiana shrimp law became effective with the summer closed season of 1958 and has been effective for two successive summers. Although rigid enforcement of this law was deemed necessary as a management tool by the industry, fishery administrators, and biologists alike, it has increased the difficulty of interpreting the shrimp statistics. Suffice it to say that pressure on the nursery ground stocks was at an all-time low during July and August 1958, and rigid enforcement was again the rule during the summer of 1959.

Thus, the increasingly larger crops of white shrimp during 1958 and 1959 were harvested during a shorter period and with much less effort and expense. In view of these circumstances, it seems inconceivable that some part of the increased white shrimp landings was not the result of this protective management.

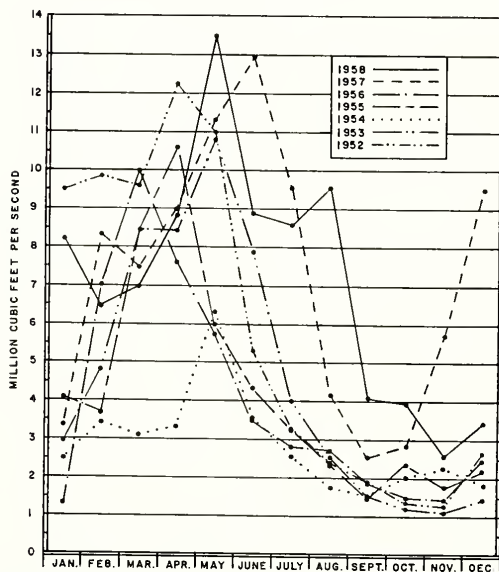
In order to correlate biological changes on the nursery grounds with the population changes of shrimp, crabs, menhaden and other estuarine species, our studies of the smaller organisms eaten by the commercial species has continued throughout the biennium. As the smaller organisms are not commercialized, they provide better clues to fundamental ecological changes, than do the commercial species themselves.

Crawfish Studies

Stimulus to research on crawfish resulted from the alarming scarcity of this popular crustacean in the Atchafalaya Floodway during the 1959 season. Crabs as well as crawfish were affected. Preliminary investigations were made by your biologist, and the facts gathered gave clues to the underlying causes of these population changes. Some of the conclusions arrived at in his lengthy report are summarized below.

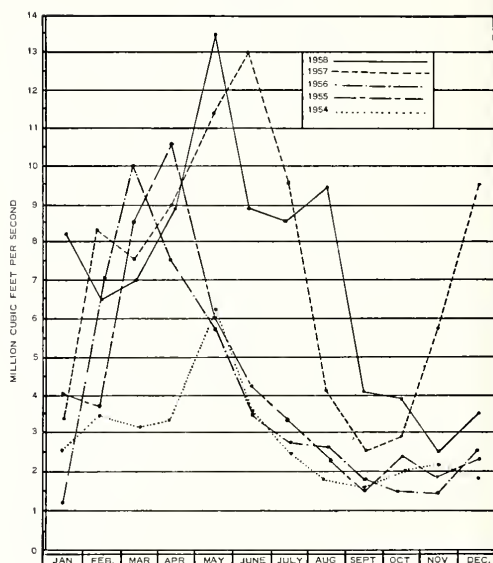
An analysis of the river-flow data provided by the U.S. Army Engineers indicated a temporary change during 1958 in the normal runoff cycle of

MONTHLY DISCHARGE ATCHAFALAYA RIVER
SIMMESPORT, L.A.



Monthly discharge data for the Atchafalaya River at Simmesport, Louisiana, during the years 1952 through 1958. Note that the normal cycle of spring flood followed by summer drought was interrupted to some extent during 1957 and drastically during 1958. In the latter year, the water did not go below the level of the swamp floor, favoring fishes which feed on crawfish or destroy their food supply. This prevented the crawfish from "digging in" for protection.

MONTHLY DISCHARGE ATCHAFALAYA RIVER
SIMMESPORT, L.A.



The normal cycle of spring flood followed by summer drought was interrupted during 1958, when water covered the Atchafalaya Floodway throughout the year, to the detriment of the 1959 crawfish crop.

the Atchafalaya River. The normal cycle consists of a moderate flow during the winter months, a crest during the spring, then a more or less rapid fall, followed by a low water period extending through the summer and sometimes through the fall.

The accompanying chart shows the flowage data for the Atchafalaya River at Simmesport from 1952 through 1958. The life cycle of the red swamp crawfish seems to be adapted to this normal weather cycle of spring flood and summer drought. When swamps go dry, the adults "dig in" for the season. While the females are thus estivating in their little caverns and tunnels at the underground water level, their eggs are laid. While the mother crawfish and their eggs are thus protected underground, their competitors and aquatic predators are engaged in a severe struggle for existence and are exposed to predation by water birds, raccoons, etc. in the drying pools and water holes.

The swamp trees, which drink up water at a rapid rate during the summer, are less active water consumers during the fall months. Autumn rainfall is generally sufficient to raise the water level above the swamp floor, and small pools are formed everywhere. Normally these are devoid of fish, which have succumbed during the summer drought. The female crawfish now come out of their hiding places on damp nights and release their young into these newly-formed pools. The young grow rapidly and usually attain marketable size by spring.

In 1958, however, the water remained over the floodway throughout the summer, instead of the swamp drying out as in other years. Hence, the female crawfish could not "dig in" except along the

levees and some of the higher ridges in the floodway. The water level finally went down in September and remained low throughout the fall, but even then, the swamp did not go dry. This, no doubt, coming at the time the leaves were falling, caused a stagnant condition which virtually exterminated the white river crawfish in the area. On the other hand, polywog catfish can survive such unfavorable conditions by skimming the surface for air, even when the oxygen level goes down to zero. These facts account for the terrific survival of young polywog catfish, which species was taken in large numbers in the crawfish traps during the 1959 season.

Even the more hardy red crawfish, under stagnant conditions, are compelled to expose their gills at the surface of the water to secure the needed oxygen. This exposes them to natural enemies which feed from above, such as waterbirds and bullfrogs. One bullfrog can devour three or four large crawfish during a single night.

A preponderance of males amongst the adult red crawfish population was noted. After reaching the adult stage, male crawfish lose their power to shed, but the females do not. A preponderance of males would seem to indicate selective destruction of soft-shelled female crawfish by the excessive fish population which survived the summer of 1958, when the back swamp areas remained under water. As the 1958 hatch of fish would have largely succumbed had the swamps gone dry that summer, the relative abundance of young fish indicates that conditions were more favorable for them than for crawfish throughout 1958.

Then there was the crab shortage and its possible cause. Female crabs must go down to the sea to spawn. Baby crabs, when less than a quarter inch across the back, begin their inward migration into estuarine waters. If they do not find water of low salinity, their chances of survival are slim. Free from their natural marine enemies and with food plentiful in the nursery areas, young crabs thrive and grow fast. There was no shortage of spawning female crabs along the Louisiana coast in recent years. Therefore, the disappearance or serious decline of an inland population simply means that the former estuarine conditions have been superseded by fluvial conditions unfavorable for young crabs. An uninterrupted flow of water from the Atchafalaya would effectively prevent the inward creep of sea water into the nursery areas of the floodway, during which period, older crabs would no longer be replaced by young migrating in from the sea.

The results of the investigation ruled out a number of proposed theories as to the cause or causes of the recent crawfish scarcity in the Atchafalaya Floodway. Three variable factors were left to be considered: the Atchafalaya River discharge, the food supply of the crawfish, and the effects of predation. These three factors were integrated into a relatively simple explanation of the crawfish scarcity of 1959, as outlined below.

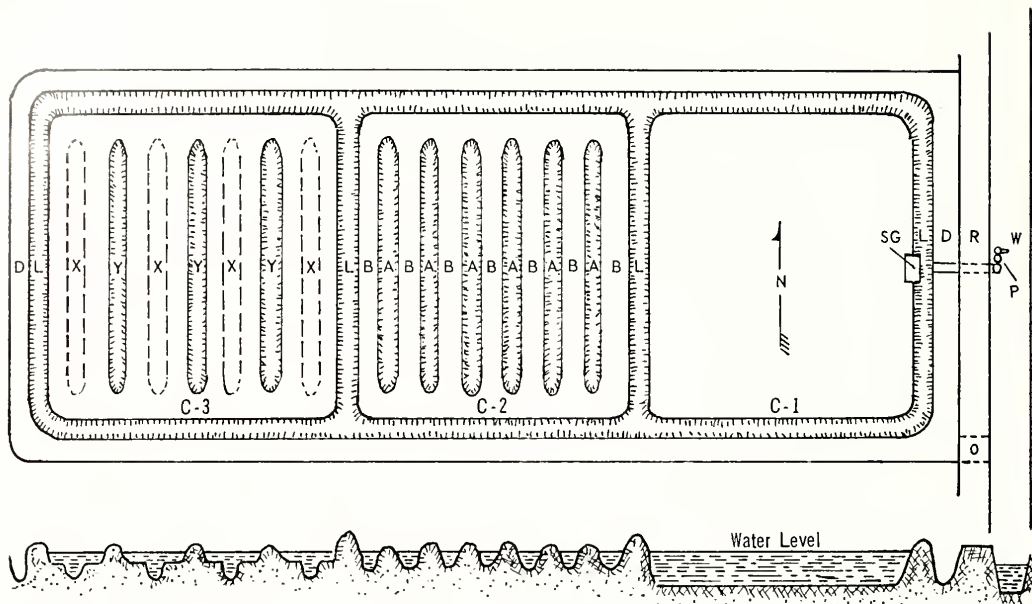
The unusual summer high water of 1958 permitted the survival of large numbers of fish in the floodway. Some, like the sunfishes, reduce the food supplies of the crawfish. Others, especially bullhead catfish, are omnivorous, feeding not only on crawfish food organisms, but on the young and soft shelled crawfish. Still others, like the black bass and bowfin (choupique), are strictly predatory, and very fond of crawfish. No doubt, it takes several dollars worth of crawfish to produce a pound of flesh; be it catfish, bullfrog, bowfin, black bass, or boy.

Incidental to the scientific study, figures were gathered at various crawfish landing points. These seem to indicate that our statistical section is not getting the records of most of the catch. At Henderson alone, some two million pounds of crawfish are landed during a normal year. This figure, for a single village, is considerably above the total statewide production according to the records of this commission. Unless correct statistics are available, they are of no value, making it impossible to determine the extent of the "ups and downs" in production and to properly evaluate them.

Pilot Crawfish Farm

Due to the efforts of local people, led by sportsmen's and business clubs, and sponsored as an emergency measure by Representative Robert Angelle in its 1959 fiscal session, the Louisiana legislature allotted \$10,000 for a crawfish study project which was to include an experimental crawfish farm to be located near Henderson, Louisiana. This was completed and dedicated in mid-October, and is now in operation, following in a general way the practices of rice culture. However, the flooding and drawdown periods were modified to correspond more closely to the requirements of crawfish, rather than to those of the rice plant. A suitable fertilization program is being carried out and proper plant foods provided for the young crawfish. If necessary, supplemental feeding will be provided later.

The main difference between the engineering of a rice field and that of the experimental crawfish farm is in the development of inner structures. It is not known whether or not rows of hills and furrows will increase production, as compared to open pond culture. For the initial project, therefore, three types of culture units were developed, and can be seen in the accompanying illustration: an open water unit engineered on the principle of a rice field; a unit with inner hills and furrows engineered as if for sugarcane culture; and a unit with small trenches alternating with their spoil banks, but separated from the banks by strips of undisturbed bottom. These three types of engineering were being tested side by side. In all units, the water can be controlled as required, so as to leave the hills exposed or covered with water in accordance with the seasonal requirements of the crawfish.



Diagrammatic sketch of Pilot Crawfish Farm. Plan view (above) section view (below).

C-1, open water culture unit; C-2, furrowed culture unit; C-3, trench and spoil bank culture unit. A, hills; B, furrows; X,

trenches; Y, spoil banks; D, outer ditch; L, outer levee; R, road; O, outlet under road; W, water supply canal; P, motor driven pump; SG, sand-gravel filter box.

The November 1959 Shrimp and Fish Kill

In the middle of November, 1959, over half a hundred reports began filtering in to commission personnel regarding widespread shrimp, crab, and fish kills in the coastal area. Your director, Mr. Rudolph Easterly, quickly organized a group of scientists from this and other divisions to probe into the causes of these reported mortalities. This technical group was amply supported by aides and other personnel and all the necessary equipment, including boats, planes and automobiles.

The reports came from an area which extended eastward and southward from St. Tammany Parish to the flanks of the Delta of the Mississippi River, thence westward to the west side of Vermilion Bay. In all, some 57 distinct spots were tallied, although some were in such close proximity to others that they do not show on the accompanying map. Some were observed by our biologists during their routine studies, and immediately investigated.

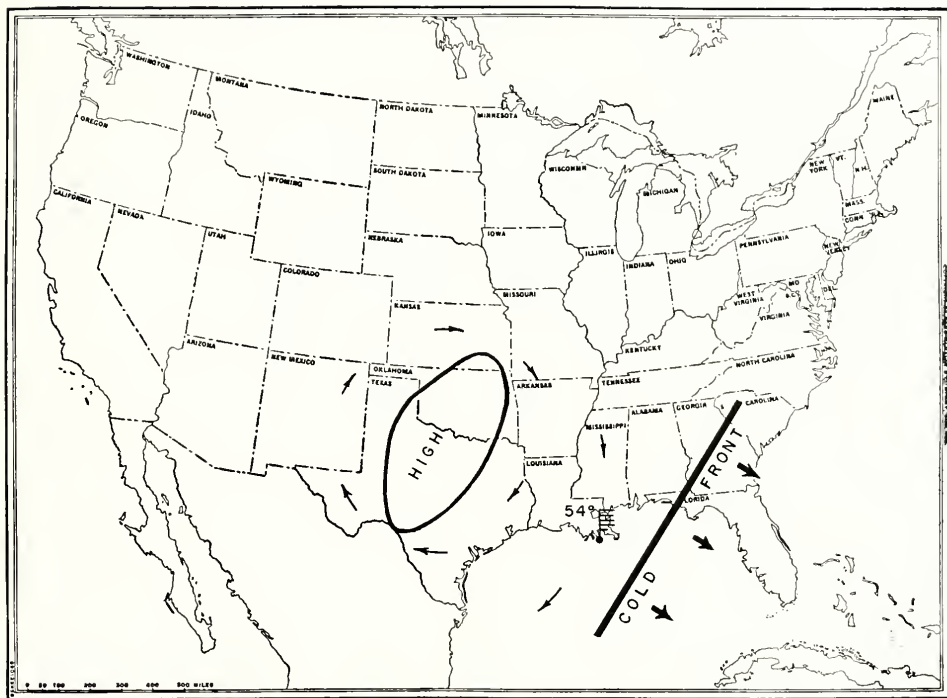
When the overall investigation was completed, the scientists and their aides had identified some 18 species of fishes and four kinds of crustaceans, including the common crab, the white shrimp and the brown shrimp. Of the fishes, the hardhead catfish and some of the shallow water minnows were the hardest hit. Relatively few of the fishes were commercial or sport species.

The widespread scope of the dieoff completely ruled out local factors, such as pollution, dredging, etc. as the basic cause. It was the unanimous opinion of the commission scientists that the primary cause was the passage of a severe cold front over the

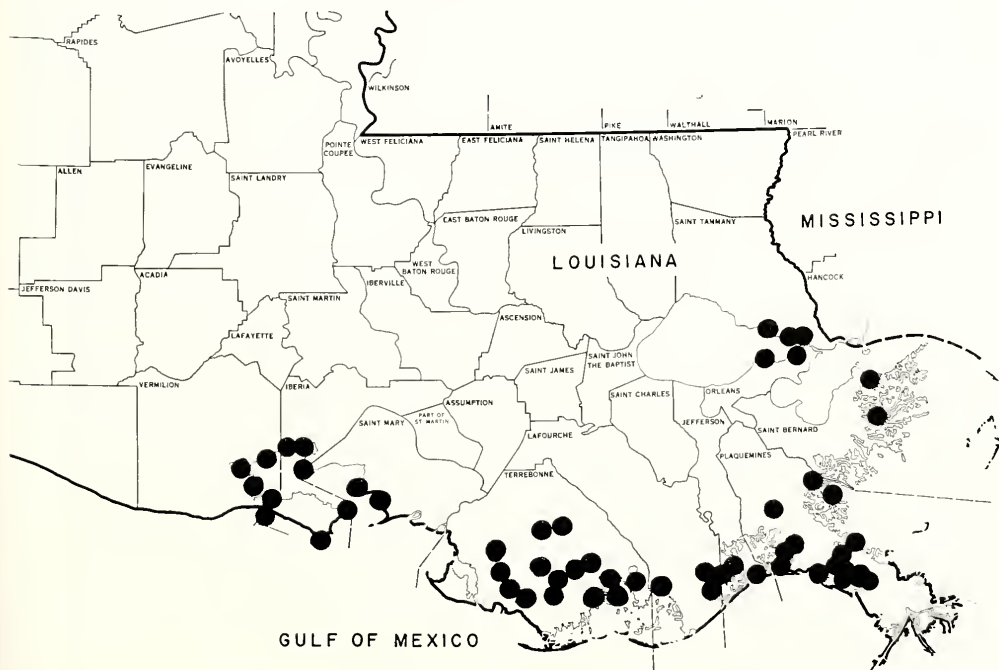
coastal area on the early morning of November 6, 1959. This produced drastic physical changes in shallow waters, and some of the marine life which happened to be in these places during the preceding warm spell, could not quickly acclimatize themselves, so became trapped. Animals numbed by the sudden cold were then exposed to reduced salinities, terrific wave action, and excessive turbidity.

On November 5, prior to the arrival of the cold front, both air and water temperatures in the coastal area hovered around the 80 degree mark, with maxima around 82 degrees. A severe cold front (see accompanying map), pushed by a high pressure system moving at the rate of 1,000 miles per day, or over 40 miles per hour, and accompanied by high, cold winds almost from due north, moved across the area and out into the Gulf shortly after midnight on November 6. By 6 A.M., the winds on Grand Isle were out of the north at 45 miles per hour and the air temperature had fallen to 54. Within 24 hours after the front passed, the air temperature had fallen to 34 degrees, a total drop of 48 degrees. There was also a tidal fall of about three feet. High winds whipping across the shallow waters no doubt further reduced the water temperature in such areas by evaporation, as ice had formed in exposed places on the morning of the 7th.

Many cold-blooded animals are very susceptible to such sudden changes, become numbed, and are unable to escape into deeper, warmer waters under their own power. Furthermore, there was much wave action resulting from the high wind, and the falling tide permitted this to scour the bottom in the shallow places, thus causing an unusually high



The Cold Front as of 6 A.M. on Nov. 6, 1959. Note northerly winds reaching 45 mi. p.h. in area of shrimp and fish kill, also high pressure system in Texas which activated the front.



Coastal Area of Louisiana affected by the passage of the Nov. 6th cold front. Black dots indicate areas of shrimp, crab, and/or fish kills. Note that deep lakes were not affected, nor area irrigated by the Mississippi and Atchafalaya Rivers.



Fish kill due to sudden cold wave.

turbidity. The water was of a soupy consistency in most of the shallow bays, due to both mineral and organic contents derived from bottom materials. The gills of the dead shrimp, crabs and fishes examined by your biologist were clogged with such materials.

Another physical factor was the rapid lowering of the salinity due to the unusually low tides which accompanied the passage of the front. It is the usual habit of marine life to swim with the tide under such conditions, but numbed by the cold, and with their gills clogged with mud, many were unable to do so. Sudden changes of salinity are very unfavorable to many marine organisms.

Population sampling brought up relatively few dead specimens as compared to living specimens of the same species. Huge crops of young shrimp, crabs, pogies and other species were found to be overwintering in deeper waters, indicating that only a minor percentage of the marine life was actually affected by the sudden change.

Although killing freezes are unusual in Louisiana coastal waters, they are not unprecedented. Perhaps the worst mortalities of record occurred during the deep freeze of January 23, 1940, which was witnessed by many persons, including your biologist. Tremendous mortalities occurred along the New Orleans lake front and in other places along the Louisiana coast. Similar catastrophic mortalities of marine species due to sudden cold waves have been reported from Southern Texas to the Carolina coasts. Texas scientists have reported shrimp, crab, and/or fish mortalities during the winters of 1940, 1941, 1947, 1948, 1949 and 1951, the most heavy damage being during 1940 and 1951.

The quick appraisal of the November (1959) fish kill along our coast has no doubt been due to coordinated action of the commission's available human and physical resources. Due credit to the individuals involved has been given in my report to our division chief, Mr. McConnell. Suffice it to say that some nine sections or divisions of this commission pooled their resources to come up with a quick answer.

Collaborating Agencies

Your biologist is grateful for information and aid

given by persons too numerous to mention, and particularly by personnel of the following agencies: U. S. Fish & Wildlife Service; U. S. Engineers; U. S. Weather Bureau; U. S. Coast and Geodetic Survey; Sewerage and Water Board of New Orleans; Louisiana State Board of Health; Scripps Institution of Oceanography; Coastal Studies Institute; California Institute of Technology; U. S. National Museum; American Fisheries Society; Gulf Coast Research Laboratory; Gulf States Marine Fisheries Commission; and the Biology Departments of Tulane, Loyola and Louisiana State Universities. He is also grateful to the personnel of other sections or divisions of this commission which have collaborated from time to time, and especially in studying and evaluating the recent (November 1959) shrimp and fish mortalities in the coastal area.

Your biologist was a member of a team of four marine biologists, all specializing in shrimp research, which were appointed by the Gulf States Marine Fisheries Commission to revise their *informational bulletin* on the "The Shrimp Fishery of the Gulf of Mexico", representing the area from the Rio Grande River to St. Marks, Florida. Other members of this team were Albert Collier, A & M College of Texas Laboratory, Galveston, Texas; Gordon Gunter, Gulf Coast Research Laboratory, Ocean Springs, Mississippi; and Robert M. Ingle, Florida State Board of Conservation, Tallahassee, Florida. The discussions of these four scientists were open to other marine biologists who contributed valuable ideas and criticism. The *informational bulletin* is prepared for use by governors, legislators and marine fisheries administrators of the several compacted Gulf States for such consideration as may be deemed appropriate in the development of laws and regulations pertaining to the shrimp fishery of their respective states.

SHRIMP INFORMATIONAL BULLETIN

Introduction

"Ideally, recommendations such as those presented here should be derived from a complete scientific knowledge of the organisms concerned. This ideal may never be attained and in the meantime the demand for shrimp and the encroachment of our industrial civilization upon the coastal environment constitute increasing threats to the stability of this resource. Therefore we offer our best thinking in terms of existing knowledge. In the past several years production of brown shrimp in the area from the Rio Grande River to St. Marks, Florida, has exceeded that of other species. There are sufficient differences in the biology of the white shrimp and the brown shrimp to require that they be treated separately rather than collectively. The pink shrimp, of lesser commercial importance in the subject area, is not being treated in this publication.

"We would like to add an additional comment on the attitude of the fishery biologist in recommending regulations. Strictly speaking a conservation measure should be written purely in terms of the known biology of the species concerned, but this is rarely feasible because of the vicissitudes of en-

forcement in the field and considerations of equity where different economic and social strata are involved. These items are outside the purview of the biologist.

"Recommendations such as are presented here should come as a proper synthesis of ideas originating in the minds of the fishery biologist, the fishery industrialist, and the fishery administrator. This committee did its best to recognize all the needs of the fishery, but because of its reluctance to assume knowledge of law enforcement limitations, the needs of industry, and the sociological makeup of the industry population, the results given here lean strongly on purely biological premises.

Biological Notes

The White Shrimp

"The following statements concerning the life history of the white shrimp, *Penaeus setiferus*, we consider to be fundamental for the framing of regulations of the fishery:

1. Most spawning occurs from April through August in the offshore¹ waters. The eggs are laid directly into the water and are not carried by the female. A female shrimp will lay between 500,000 and 1,000,000 eggs at a spawning.
2. The eggs hatch within a few hours and the young become part of the plankton, being carried about by oceanic currents. Only those young survive which are carried into favorable nursery areas in relatively fresh estuarine waters.
3. In Louisiana, Mississippi, and Alabama the young appear in abundance on the inside fishing grounds by mid-June; in Texas and west Florida by mid-July. In the nursery areas during the summer the young shrimp as individuals grow very rapidly, generally increasing their weight more than four times each month.
4. The larger shrimp eventually find their way to the spawning grounds in offshore waters of higher salinity.
5. As winter approaches, the larger shrimp move from nursery grounds to offshore waters, leaving the smaller shrimp in the nursery areas, where growth is retarded by lower temperatures.
6. With the advent of spring and the warming of the waters, the small shrimp which wintered over in the nursery areas resume a very rapid rate of growth, and consequently they move to the offshore waters where spawning takes place. At their first spawning period, these shrimp are approximately one year old.

The Brown Shrimp

"Although research on the brown shrimp, *Penaeus aztecus*, has not yet produced information com-

parable to that available for the white species, the following statements can be made at this time:

1. Spawning definitely precedes that of the white shrimp, usually by two to three months. It occurs farther offshore.
2. As far as is known growth rates approximate those of the white shrimp.
3. Brown shrimp leave the nursery grounds at a smaller size than the white shrimp. This migration takes place sometime during the period May through September, the time varying somewhat according to locality.
4. The adults are active at night, apparently burying themselves during the day. The smaller sizes found in the nursery areas do not seem to be as strongly nocturnal.

Recommendations

"The unexpected and unexplained drop in white shrimp production gives reason to pause about the idea that the size of spawning stock is not related to the resulting crop and requires no protection. Since we have no information on which to establish the need for regulations to protect the spawning stock, to say nothing of formulating them, the recommendations which follow are based only upon the assumption that it is advantageous to protect the small shrimp.

Closed Seasons

Nursery Areas

"*White Shrimp*: The first closed season for nursery areas should be, for the area east of the Louisiana-Texas boundary, to and including St. Marks, Florida, from July 1 to August 31 (both dates inclusive). The closed season for the nursery areas of Texas should be from July 15 to September 15 (both dates inclusive).

"The second closed season for the nursery areas in all states should be from November 1 of one year to March 31 (both dates inclusive) of the following year.

"The first closed season is suggested to protect the small shrimp during the period of their most rapid growth. The different season suggested for Texas waters results from the fact pointed out above that there the young shrimp appear later in the nursery areas.

"The second closed season is suggested for the purpose of protecting the small shrimp that are wintering over in the nursery areas. These shrimp produce the spring run.

"*Brown shrimp*: When the migrations of young brown shrimp in all of the Gulf states are considered as a whole, a universal closed season for conserving the young would be from March 1 through April 30 (both dates inclusive). On going from state to state the opening date could be delayed a month or more as required.

Offshore Waters

"*White shrimp*: The offshore waters should remain open to fishing in all states throughout the entire year. Generally, small individuals do not

¹We define nursery areas for this species to be those areas landward of the three fathom line, and offshore waters to be those seaward of the three fathom line, in the Gulf of Mexico.

predominate in the shrimp population in offshore waters.

"Brown shrimp: In recent years there have been cases of excessive catches of unduly small shrimp by trawlers operating in offshore waters. At this time we can only recommend that the possibility of discretionary regulation and its consequences be carefully studied by those concerned. See below.

Note: Time and dates shown for white and brown shrimp are only approximate for Florida which has already adopted the system of regulation recommended in the concluding comments below.

"White and brown shrimp: We recommend no size limits and that those now in effect be abolished.

"When a size limit is imposed the basic purpose of the regulation is defeated by culling. Shrimp smaller than the legal size which have been killed in the fishing operation are discarded. The closed seasons recommended above, if strictly enforced, should provide adequate controls. While of no biological significance it is a fact that size limits are difficult to enforce, which further detracts from their usefulness.

Night Fishing

"White and brown shrimp: Night fishing should be permitted in all waters during open seasons.

Gear

"White and brown shrimp: No limitations are suggested on size of trawls. We have no evidence that trawling is harmful or beneficial to the bottoms. The criticism that large trawls take an undue quantity of shrimp from the inside waters is not sound since it makes no difference to the shrimp population whether or not the shrimp are caught by a large or a small trawl. Competition between units of the fleet is an economic rather than a biological problem. Again we believe that the recommended closed seasons properly enforced should suffice for adequate control.

"The size of mesh used in a trawl controls to a marked degree the size of shrimp caught. Where enforcement is feasible, mesh regulations are useful.

"The data we have shows that no significant quantities of important commercial or sport fishes are taken in shrimp trawling operations. In order to permit the escape of the small numbers of important fish which are caught, it would be necessary to increase the size of the mesh to an extent which would seriously decrease the ability of the trawl to catch shrimp. The value of the shrimp caught by trawling operations is so vastly greater than the value of the fish incidentally caught, that to curtail shrimp-ing in order to prevent the capture of these fish would be unjustified.

Bait Shrimp

"The problems of the live bait shrimp fishery should be recognized as being separate and dis-

tinct from those of the commercial food shrimp fishery.

Concluding Comment

"One of the Gulf states has been opening and closing some of its waters according to the prevailing size of the shrimp as determined by sampling the population. Elsewhere a segment of the industry itself has taken the initiative in promoting the enactment of legislation which is intended to prevent undesirable destruction of small brown shrimp, and which incidentally would reduce the fishing pressure on white shrimp during spawning. If adopted by the legislature of the state concerned, the proposed act would provide limited discretionary regulation by its conservation agency. Both of these programs are admittedly experimental in nature, the latter more so than the former.

"This type of "trial and error" regulation was suggested a number of years ago, and we believe that it can be very useful, provided it is developed in the light of existing scientific knowledge and calls for its own evaluation by a properly planned and concurrent biological program."

COASTAL WASTE

CONTROL

JACK HOOD

Supervisor



Showing C.W.C. inspector preparing to board an oil tow underway.

Enforcement of the Coastal Waste Control program has been designated to the Division of Oysters, Water Bottoms and Seafoods by the Stream Control Commission, which includes patrol of oil field installations and drilling operations in the coastal area from southwest of Houma to the Mississippi state line. This section has been functioning more than twelve years.

For the past three years a 34-foot patrol boat, equipped with radio communication apparatus which is linked to the Commission's headquarters, has been operated on a year-round basis enforcing the Commission's regulations in coastal streams.

In July 1959, Coastal Waste Control forces were



Showing an average barge used in inland waters, with an adequate gondola type barge on shaker side to catch all O.E.B.M. cuttings and waste.

doubled by the addition of another boat, and an Inspector and Boat Captain, which provided for greater efficiency, since twice the area could be covered in half the time.

Thus the patrol boat C. W. C. No. 1 was designated to patrol from the Mississippi River to Lake Decade southwest of Houma, Louisiana, while the C. W. C. No. 2 is designated to patrol from the Mississippi River east to the Mississippi state line.

Primary efforts of the patrol are to work with and patrol oil developments on our coastal streams to prevent pollution of waters and marshes caused by oil field wastes which result from oil operations and explorations. This pollution is caused by the purposeful or accidental discharge of various harm-

ful wastes which produce a detrimental effect upon fish, oysters and water bottoms.

The object of this patrol is to educate operators to the necessity for the proper disposition of crude oil, waste oil, sludge and oil and chemical-bearing mixtures, and to make checks against carelessness, negligence and violations, and to make necessary arrests in case of violations. These rules govern disposal of waste, oil, oilfield brine and other materials resulting from the drilling for, production of, or transportation of oil, gas, or sulphur, and also include the inspection of disposal devices, pipeline valve leaks, barges used for crude oil transportation, loading racks, barge loading outlets, and similar



Showing one of the major company's largest operations in southeast Louisiana coastal area.



Showing pre-fab barge battery storage on bottom.

operations where precautions should be taken against spillage.

While there is much room for improvement, the operators in the patrolled areas have been increasingly more cooperative and arrests for flagrant violations have been negligible. Most of such violations are the result of carelessness, and when such

violations are not corrected within a reasonable length of time, the matter is referred to the Stream Control Commission. The decisions of the Stream Control Commission are direct and have been most effective. A constant patrol is necessary in order to control these offenders who are at present in a minority.



CWC No. 1 approaching oil tow under way, for inspection.



Oil tows underway such as these are inspected when encountered enroute to various areas.

REFUGE DIVISION

RICHARD YANCEY

Chief

THIS DIVISION is responsible for the management of five separate coastal marsh areas totaling 250,000 acres, and one upland water fowl refuge of approximately 3,300 acres. This includes the 85,000 acre Marsh Island Wildlife Refuge in Iberia Parish, the 83,000 acre Rockefeller Wildlife Refuge in Cameron and Vermilion Parishes, the 66,000 acre Pass-a-Loutre Waterfowl Management area in Plaquemines Parish, the 15,000 acre State Wildlife Refuge in Vermilion Parish, and the 3,300 acre Coulee Wildlife Refuge in Morehouse Parish.

These areas have become increasingly important in recent years since much of Louisiana's wildlife habitat has been encroached upon by man's activities. It is anticipated that they will be of much greater value in the future as other adjacent wildlife lands are damaged through the construction of navigation, drainage, flood control, and a multitude of other development projects that do not take into consideration local wildlife values. These areas may eventually serve as the last remaining favorable habitat to which many forms of marsh wildlife can retreat. It is remarkable that this series of events was recognized by those who were responsible for the establishment of the Refuges beginning in 1911.

From the standpoint of national importance these areas are most valuable to migratory waterfowl. During recent years approximately 600,000 ducks and 150,000 blue and snow geese utilized the refuges during the month of December. In addition many more hundreds of thousands stopped over temporarily during the early fall and spring migrations while enroute to other regions. All waterfowl utilized the vast food supplies produced on the refuges and also took advantage of the protection within their boundaries during the time that waterfowl hunting seasons were in progress.

These areas also served as a haven for large numbers of coots, rails, snipe, shorebirds, and fur bearing animals, such as muskrat, mink, otter, nutria, and raccoon. In addition the Refuges are about the last retreats where alligators can be found in extremely large numbers.

During the past two years management of all areas has been divided into four major phases. This includes administration, research, development, and maintenance. Three of the refuges were received by the State of Louisiana under Deeds of Donation from separate foundations and estates. Special care



RICHARD YANCEY

has been exercised to insure that all terms and stipulations agreed to when the properties were accepted have been closely adhered to during the course of operations. Each deed set forth very specific conditions under which the refuges would have to be managed and reversionary rights were retained by the donors in the event that the State violated any of the contract stipulations.

All new policies pertaining to the management of the areas are established by the Louisiana Wild Life and Fisheries Commission during regular monthly meetings and these directives are channeled to the Refuge Division by the director. These policies are established within the limitations set forth by the Deeds of Donation. Many projects, particularly maintenance, are carried out on these areas by Refuge Division personnel. All engineering and survey services are supplied through cooperation with the Department of Public Works. Contracts are let out on development projects that exceed the capacities of the Refuge Division.

Considerable mineral activities, particularly oil and gas, now prevail on the areas. These are closely governed by the Louisiana Wild Life and Fisheries Commission, working in cooperation with the State Mineral Board. All new leases, either geophysical or development, include rules and regulations to protect wildlife and its habitat against damages. These stipulations are very carefully drawn up and incorporated in the leases since un-controlled mineral activities would bring about a great deterioration of wildlife and waterfowl habitat in the marshes.

Research studies are carried out by trained personnel in order to prepare a sound basis for development projects. In addition, continuous evalua-

tion efforts are made as a check against development projects that have been previously completed. This is of considerable benefit in the management of existing water control areas for the greatest production of food and other favorable conditions for wildlife. It is felt that completely sound development projects can be initiated only through the findings of research.

The maintenance phase of the program includes the upkeep of all existing facilities, such as levees, water control structures, boats, buildings, as well as a continuous patrolling of the areas to prevent

possible violations of regulations.

On June 27, 1957, hurricane "Audrey" brought about devastating losses on the refuges in southwest Louisiana. During the past two years much of the work carried out has been directed towards rebuilding the facilities in these areas. Special plans have been incorporated in all projects in order that losses will be minimized in the event of another similar storm in the future. The details of the work accomplished during the past two years are included in this report and several references are made to future plans.

COULEE WILDLIFE REFUGE

ALLAN B. ENSMINGER

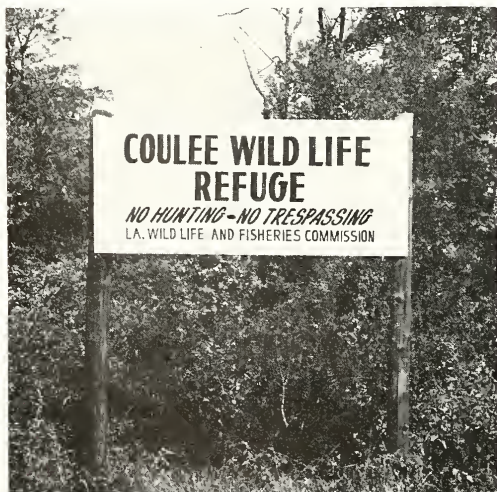
Biologist

The Coulee Wildlife Refuge was transferred from the Fish and Game Division to the Refuge Division in January 1958. Since that time numerous jobs have been carried out in order to further perpetuate this 3,666 acre tract of bottomland hardwood timber as a desirable refuge area for approximately 30,000 wintering waterfowl. Coulee Refuge also provides suitable protection for a large number of white-tail deer.

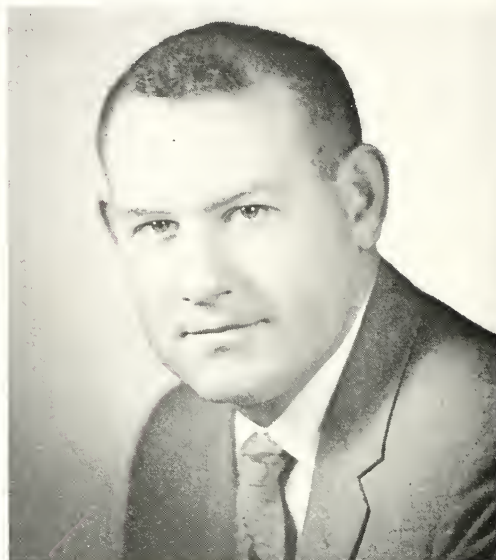
The two water control areas which consist of approximately 1,000 acres provide a resting and refuge area for ducks which feed in the surrounding area during the waterfowl season.

Development

The entire boundary of the Coulee Refuge was plainly marked by refuge signs and a white painted line during 1958. Along the northern and western



Coulee Refuge in Morehouse Parish provides a resting area for approximately 30,000 ducks each winter.



ALLAN ENSMINGER

boundary a bulldozer was employed to clear a line through the brush in order to establish a well defined boundary right-of-way. It will be necessary to clear this line every two years to prevent the re-establishment of brush in the right-of-way.

The Department of Public Works provided engineering services for this job in order to assure that the line would be established along the property line of the refuge.

A complete contour survey was made by the Department of Public Works of that portion of Coulee Refuge locate west of the Coulee drainage canal. This information will be used in any future development of a green timber basin for wintering waterfowl. Due to the fact that the Morehouse Police Jury maintains the Coulee drainage canal, an appreciable amount of spoil has been deposited along the western bank of the drainage canal. To develop an additional water control area on the refuge approximately 6 miles of new levee would be required. It is felt that an additional water area on Coulee Refuge would concentrate an even larger body of wintering ducks which could be utilized by the sportsmen of north Louisiana.



A flock of Mallards are flushed on Coulee Wildlife Refuge in North Louisiana.

Maintenance

The maintenance work on Coulee Refuge consists mainly of minor repair jobs along the levee system on the upper and lower water control areas. During the summer of 1958 a large washout occurred in



A well defined boundary line was cleared on the northern and western sides of the Coulee Refuge.



Additional spill pipe was required on the lower basin at Coulee Refuge.

the southeast corner of the upper basin which allowed the basin to drain. This break was repaired by equipment belonging to the Morehouse Police Jury. A very substantial levee was constructed and no future washouts are anticipated in this area.

During September of 1958 it was necessary to install approximately 60 feet of additional spill pipe on the drainage structure of the lower impoundment. This project was done at the same time the bulldozer was cleaning the boundary in order to have this equipment cover the installed spill pipe.

It is expected that one or two small leaks in the

upper and lower basins will have to be repaired within the next two years. These leaks are the results of rotting logs that were covered by the original placement of the spoil from the two drainage canals. This work should be of a minor nature and require only a small expenditure.

A new gate will be needed along with a small amount of fencing to discourage trespassing along the southern boundary of the Refuge.

Frequent patrol trips have been made by agents of the Enforcement Division.

Research

A total of 20 live alligators were transplanted from the Rockefeller Refuge to Coulee in an attempt to re-establish these animals. There is an ample supply of food available for alligators in both of the impoundments. Frogs, fish, young beavers, snakes, nutria, and other forms of aquatic animals are present on Coulee. All alligators were marked by a system of toe clipping for future scientific studies in regard to growth of alligators in their natural habitat.



Live alligators were transplanted on Coulee Refuge in an attempt to establish these valuable animals in North Louisiana.

An experimental planting of 800 pounds of brown top millet was made in the lower basin during August of 1959. An airplane was retained to plant the seeds and a suitable crop of millet was obtained. It is expected that there will be an appreciable amount of volunteer growth made next spring and provide a fair amount of feed for the wintering waterfowl.

In addition to the brown top millet seeds that



Aerial planting of brown-top millet at Coulee Refuge was successful.

were available to the ducks during the winter months, there was a lot of natural waterfowl food plants produced in both of the basins. A very heavy growth of duck weed and coontail was produced in the upper basin, while spike rush and sedges were the more common plants in the lower basin.

A small population of wood ducks used the refuge as a nesting area during the summer of 1959.

Due to the fact that the lower basin is a shallow water impoundment much of this basin is exposed during the summer months. A dense growth of willow has occurred in much of this basin and it will be necessary to kill this plant by some means in the near future in order to maintain as much open water area as possible on the refuge.

A duck banding program will be carried on if water conditions are determined proper during the next two waterfowl hunting seasons.



Willow, ash and button bush are invading the lower basin at Coulee Refuge.

PASS-A-LOUTRE WATERFOWL MANAGEMENT AREA

ELLIS W. LOGA

Manager

ALLAN B. ENSMINGER

Biologist

The Pass-a-Loutre Waterfowl Management area was transferred to the Refuge Division from the Fish and Game Division on May 1, 1958. A considerable amount of development and maintenance work has been done on the area in the past twenty months. Two very successful hunting seasons have been completed. During the 1958-1959 season a total of 1143 two day hunting permits were issued and of this total 963 hunters showed up to make the hunts. Due to the short duck season for 1959-1960 a total of 648 permits were issued with a total of 569 hunters making the trip. The number of hunters, fee charged, and the money derived from the present shooting program since its initiation in 1954 are shown in Table No. 1.

TABLE No. 1

Waterfowl Season	Number of Permits	Fee	Money Derived
1954-1955	576	\$ 2.00	\$ 1,152.00
1955-1956	1523	2.00	3,046.00
1956-1957	660	10.00	6,600.00
1957-1958	569	10.00	5,690.00
1958-1959	1143	5.00	5,715.00
1959-1960	648	5.00	3,240.00
Total Six Seasons	5119		\$25,443.00

The Pass-a-Loutre area, which comprises more than 66,000 acres of marshland near the mouth of the Mississippi River, provides some of the best duck hunting to be found in Louisiana.

In carrying out the public hunting program the Commission uses a system of applications, drawings, and permits to insure that everyone has an equal opportunity to make a two-day hunt. The fee for the two-day trip has been reduced from \$10.00 to \$5.00. Even at the original fee of \$10.00 the trip to Pass-a-Loutre offered the best duck hunting buy to be found anywhere. In exchange for the small cost the Louisiana Wild Life and Fisheries Commission provides boat transportation from Venice, Louisiana, to Pass-a-Loutre and return. At Pass-a-Loutre, a comfortable camp, cooking gear, decoys, duck boats, butane cooking system, plus the two-day hunt on one of the finest hunting marshes is provided.

Waterfowl retrievers were permitted as part of the shooting program for the first time during the 1958-1959 season. A total of 47 dogs were used by hunters the first season and 7 the second season.

In addition to the section of Pass-a-Loutre reserved for the public camps one-third of the area is open to those who wish to make a hunt using their personal equipment and facilities. A total of 1506 free 4-day permits were issued to 422 hunters during the past two seasons to hunt on this portion of Pass-a-Loutre. Frequent patrols were made to insure against violations.

Development

Over one hundred earthen plugs have been placed in breaks through the natural pass banks on the area in the past one and one-half years. Several of these plugs actually amounted to low levees built along the pass banks. Most of these plugs will be permanent plugs and will not be removed. Only the key plugs will be removed to allow river water to flow into the ponds each spring and early summer. These earthen plugs were installed through the use of the Commission owned dragline. This work was undertaken in order to encourage the production of waterfowl food plants by restricting drainage of the marshes during low tide in the river and by reducing the reverse flow of salt water from the passes into the marshes during the later summer. In those



A successful hunt at Pass-a-Loutre waterfowl management area.



Numerous small plugs and low levees were constructed at Pass-a-Loutre to control water depths in the ponds and encourage the production of waterfowl food plants.

marshes where water conditions were partially stabilized, excellent stands of desirable aquatic vegetation were produced. This served to not only attract but hold a high waterfowl population during both hunting seasons. Additional plugs and water control ditches will be constructed on the area during the next two years to further improve this fine waterfowl hunting area.

A landing strip suitable for use by the small airplane owned by the Commission was constructed at Pass-a-Loutre during the summer of 1959. This strip will be used in conjunction with the patrol,



Tons of aquatic waterfowl food plants were produced in the shallow water ponds at Pass-a-Loutre.

maintenance, development, and research activities being carried on by the Refuge personnel.

Material has been purchased to build new wharf and docking facilities at the main headquarters site. This work should be completed by mid-summer of 1960 and will provide ample docking space for the large boats used in the hunting program.

Permission has been granted by the Freeport Sulphur Company for the use of their suction dredge to fill the main headquarters yard site in the near future. In anticipation of this project, a reten-



Dense stands of delta duck potatoes such as above are preferred feeding areas for ducks at Pass-a-Loutre.

tion levee has been constructed by the refuge dragline on the upper side of the headquarters site. Construction is under way on a retaining levee along the front pass and upon completion of this project, the site will be ready for the dredging operation. Upon completion of the fill it is believed that most of the existing wooden walkway can be removed and replaced with shell and concrete sidewalk, thus improving the overall appearance of the headquarters site.

Plans are being made to have the Department of Public Works make a complete boundary survey of the area. Upon completion of the survey a complete set of appropriate signs will be installed along the boundary. This will give the Commission more rigid control of hunting activities in the area and further assure the hunters who pay for their two-day trip of not having to compete with unauthorized persons for hunting room. This is a problem which is increasing annually on Pass-a-Loutre and it is felt that only through a complete posting of the boundary will this problem be solved.

Maintenance

Headquarters Area

Extensive maintenance work was necessary on the facilities at the main headquarters site. During the summer and fall of 1958 the kitchen and dining room were completely renovated and new fixtures installed. Other minor repair jobs were completed around the buildings and walkways.

Work began on the renovation of the main headquarters building again in July of 1959. Four additional bedrooms were installed in what had been more or less wasted space. This renovation work was completed in November of 1959. Plans have been made to complete the renovation of the remainder of the building in the summer of 1960. All of the repair and renovation work was done by refuge personnel.

Public Hunting Camps

Material was purchased and transported down to the area in order to make the necessary repairs to the nine public camps. Indoor bathroom facilities were installed in seven of the nine camps and river water was piped into these camps for use in the bathrooms and kitchen sinks.

Plywood was placed inside of four of the camps where the original celotex material was beyond repair. It was necessary to replace the roof on one of the camps. Flashing was installed over all of the doors and windows of the camps to prevent any further damage to the interior finish by water being blown into the camps. Most of the camps were painted throughout and were in fine condition for the 1958-1959 and 1959-1960 duck seasons.

Decoys, push poles, paddles, and various utensils and supplies for the public hunting program were stored at the main headquarters site and were thoroughly cleaned before being stored.

Six wharfs were built in front of the camps which greatly facilitated the loading and unloading of the hunters and their gear.

Equipment

The patrol boat "Sprig" was sent to the Commis-

sion wharf in New Orleans twice for repairs. Numerous outboard, tractor, boat, and dragline repairs were made by the refuge personnel.

It is expected that a portion of the existing marine equipment at Pass-a-Loutre will have to be replaced within the next two years.

Marsh

Several earthen plugs were removed last spring in order to permit silt laden river water to flow into some of the marsh ponds. Once inside the ponds the silt settles out. This silt is very fertile and is necessary to maintain the ponds and mud flats as choice waterfowl food producing areas. As soon as the river rises this season the plugs will be removed for a short time again.



Fresh water three square grass was present along most of the pass banks at Pass-a-Loutre during 1959. This is a valuable food plant for geese, ducks and some fur-bearing animals.

The cattle being pastured at Pass-a-Loutre have been confined to two limited areas where they would not cause any amount of damage to the vegetative cover along the pass banks. The pass banks are maintained by the annual deposition of silt. In past years a large number of cattle had been permitted to overgraze and damage vegetation on the pass banks. Good grass cover is very important in trapping silt and building up the pass banks in elevation, therefore, overgrazing is highly detrimental and should be prevented in the future. Since the restriction of the cattle to two small areas good stands of vegetation have become re-established.



High river stage at Pass-a-Loutre in 1958 was of little help in the deposition of silt because of the absence of vegetation on the pass banks.

Research

Intensive waterfowl kill data has been collected during the past six seasons at the public camps. During the 1959-1960 season information gathered by Commission Biologist at Pass-a-Loutre was used by the Bureau of Sport Fisheries & Wildlife, Section of Wildlife Biometry, in a special Mississippi Flyway kill survey. This basically involves checking the known kill against that reported by hunters from questionnaires mailed out after the hunting season. The end result will be to determine the possible accuracy of any questionnaire kill surveys that may be made in the future.

In addition to this information numerous wings were collected from gadwall, blue-winged teal, lesser scaup, and ringed-neck ducks. (See table 2)

A random check of the age ratio was made of all species bagged at Pass-a-Loutre and is presented in table 3. From the information assembled during this study there was a ratio of 3.91 adults to 1 immature. This ratio is in reverse of the kill in a normal season. It is a known fact that adult ducks are more cautious and reluctant to come to decoys, therefore, there should be a predominance of immature birds in a hunter's kill.



Complete bag records were kept by biologist at Pass-a-Loutre and valuable information was gained in regard to age, species and number of ducks killed.

TABLE No. 2

Waterfowl age ratio based upon wings collected at Pass-a-Loutre during 1959-1960 season:

<i>Species</i>	<i>Adult</i>	<i>Immature</i>
Gadwall	212	41
Blue-winged Teal	134	10
Ringed-neck	21	15
Lesser Scaup	11	4
Total	378	70

TABLE No. 3

Age ratio of ducks killed at Pass-a-Loutre during 1959-1960 Season.

<i>Species</i>	<i>Adult</i>	<i>Immature</i>
Baldpate	119	12
Pintail	84	64
Green-winged Teal	72	9
Lesser Scaup	70	19
Mallard	68	21
Blue-winged Teal	34	2
Mottled Duck	15	12
Shoveller	11	4
Black Duck	3	2
Canvasback	3	1
Gadwall	3	0
Ruddy Duck	0	1
Total	482	147

The total kill of the hunters participating in the public camps for the 1958-1959 and 1959-1960 seasons are presented in Table 4. The information presented for the two past seasons gives an average kill per hunter's effort of 1.90 during the 1958-1959 season and 1.59 during the 1959-1960 season. It is felt that this decrease in average kill was due to the scarcity of immature ducks.

TABLE No. 4

Waterfowl bag check of hunters using public camps at Pass-a-Loutre.

<i>Species</i>	<i>1958-1959</i>	<i>1959-1960</i>
Gadwall	1,367	452
Baldpate	617	260
Blue-winged Teal	512	317
Lesser Scaup	372	182
Green-winged Teal	230	209
Mallard	220	103
Shoveller	129	40
Pintail	121	197
Mottled Duck	41	42
Ringed-neck	27	10
Canvasback	11	1
Merganser	7	0
Ruddy Duck	5	0
Black Duck	3	5
Greater Scaup	3	0
Red Head	2	0
Fulvous Tree Duck	1	0
Buffle Head	1	0
Wood Duck	0	2
Total	3,669	1,820



A morning bag for four duck hunters at Pass-a-Loutre.

STATE WILDLIFE REFUGE

HAMPTON GREENE
Refuge Manager

ROBERT H. CHABRECK
Biologist

Headquarters Camp

The remodeling of the headquarters camp on State Wildlife Refuge was completed in August 1958. This camp is now equivalent to the other refuge headquarters insofar as appearance and convenience. With the assistance of carpenters from the Louisiana Wild Life & Fisheries wharf in New Orleans, costs on this complete remodeling job were held to a minimum.

The remodeling job included sheet rocking and finishing the walls and ceilings, rebuilding the kitchen and bath, replacing screen on the porch with jalousie windows, replacing all door and window facings, tiling the floors and replacing plumbing and electrical fixtures. When remodeling was completed, new furniture was put in the camp.

Bulkhead Repair

The bulkhead at the State Wildlife headquarters camp was constructed to prevent erosion of the headquarters site and serve as a boat dock. During the original construction standard wire cable was used to tie-back the structure. But, as a result of a high salt content of the soil and heavy pressure against the bulkhead, the cables broke causing the structure to lean approximately fifteen degrees.

A dragline was immediately brought to the site and, under the supervision of a Department of Public Works' engineer, all fill was excavated from behind the bulkhead. The bulkhead was then pulled back in place with come-a-longs and new galvanized cable used to anchor the structure to tie-back piling.

After this phase of the work was completed the area behind the bulkhead was back-filled and dressed with a layer of clam shells.

All work on the structure was completed in September 1959.



State Wildlife Refuge Headquarters

Boat Slip

With the use of a three-quarter yard dragline a boat slip was completed at Intracoastal City which will serve as a place to dock refuge boats and service the refuge. The site is owned by the Louisiana Wild Life & Fisheries Commission and gives refuge personnel full control over the slip.

An old slip existed at this location but had filled in with silt deposits and could not be entered except during high tides. The slip was deepened and a boat dock constructed.

All work was performed by refuge personnel under the supervision of an engineer from the Department of Public Works.

Boundary Markers

As a result of hurricane "Audrey" most of the signs marking the boundary of State Wildlife Refuge were destroyed. The signs had been placed at intervals around the entire boundary. In addition, large wooden signs were erected at the mouth of all bayous leading onto the area. The signs stated the name of the bayou, the name of the refuge and warned against trespassing.

Survey of Refuge

A complete survey of the refuge was made by Munson-Patout & Marie, Consulting Engineers of New Iberia, Louisiana, during the summer of 1959. All boundary markers, existing facilities, old trapping camp sites, trapping ditches, and numerous earthen dams were located. A completed map and field notes are on file in the Refuge Division office in New Orleans.

ROCKEFELLER WILDLIFE REFUGE

NED W. CRAIN
Refuge Manager

ROBERT H. CHABRECK
Biologist

Rollover Bayou Structure

During hurricane "Audrey" on June 27, 1957, tides in excess of nine feet covered the marshes of Rockefeller Refuge. As the winds diminished following passage of the storm this flood of water rushed back toward the Gulf of Mexico with terrific force, reopening closed drainage systems and damaging water control structures and levees.

Two months prior to the hurricane a large water control structure had been completed on Rollover Bayou, a major drainage outlet in the southwest corner of Vermilion Parish. This structure was designed and installed as a barrier to incoming salt water from the Gulf of Mexico. Four separate gates were included, each 10 feet wide, to be opened for drainage of excess waters from the marshes to the north or for boat passage. The gates were opened before the hurricane, but the racing tides rushed around the ends of the structure gradually cutting deep channels. Fortunately the structure remained in place while this washout occurred.

At first the magnitude of the damages was not realized and refuge personnel made numerous attempts to fill in the gaps at the ends of the structure. Finally the Department of Public Works was asked to survey the damages and it was decided that because of the extent of the damages the repair work should be done by contract.

This job included an extension at each end of the structure using interlocking steel sheet piling, the placement of a submerged rock covered mat in front of the structure to prevent farther deepening of the bayou, and the rebuilding of the banks to their original position.

The Department of Public Works advertised for bids on the job and the contract awarded to the lowest bidder. The contractor began work in the fall of 1958 and the job was completed in January 1959. All work on the job was carefully inspected by engineers from the Department of Public Works. This water control structure is in excellent operating condition at this time.

Seaplane Ramp

Since Commission owned airplanes frequently visit Rockefeller Refuge a seaplane ramp was constructed to facilitate the loading and unloading of passengers and equipment and safe docking and storage of the planes. The ramp was constructed in an existing canal three hundred feet southwest of the East End Camp.



Newly constructed seaplane ramp in use by Commission airplanes at Rockefeller Refuge.

Preliminary surveys for the seaplane ramp were made by the Louisiana Department of Public Works. Then preliminary drawings were made and submitted to the Louisiana Wild Life & Fisheries Commission for approval. Final plans and specifications were then prepared and sealed bids were solicited through regular channels. The bids were publicly opened in May 1959, and contract awarded to the low bidder.

Cresote treated piling, sills, and decking were used throughout the structure. Galvanized steel tie-down rings were conveniently spaced throughout the platform. The approach to the ramp was set at a minus 4.5 feet elevation, while the platform sits at an elevation 4.5 feet above mean sea level. A shelled road was then constructed by Refuge personnel to the ramp for access by automobile.

All phases of the work were carefully inspected by a public works' engineer.

Boat Opening

In 1954 a canal was dug along the north property line of Rockefeller Refuge, connecting the Humble and Superior Canals. Original plans called for a lock or boat opening on the canal at its intersection of the Humble Canal, however, the boat opening was delayed and several problems were created.

The changes created in the drainage patterns of the area after the construction of the canal caused serious management problems on the Refuge. The canals, as they exist, provide a means of navigation for all phases of refuge work. Heavy equipment, such as draglines, must be moved about the refuge on barges, consequently it is necessary that the canals remain passable at all times. However, salt water from the Gulf of Mexico after drought periods or very low tides can move in through the Humble Canal and then via the Property Line Canal and Superior Canal, make its way to Grand Lake, as well as, to other parts of the Refuge. Grand Lake is a fresh water reservoir from which irrigation water is pumped for rice farming. Since rice can tolerate only a small amount of salt water the reser-



Most of the 42 walkways to the water control gates inside the impoundments at Rockefeller have been repaired or replaced since hurricane "Audrey".

voir can be easily contaminated. When the water becomes contaminated persons with rice growing interests become very alarmed. In the past the only solution has been to place an earthen plug in the property line canal when it became evident that salt water was entering the rice reservoir area and the Superior Canal in the heart of the Refuge. Then after placement of the plug the use of the canal for refuge navigation ceased. At the same time, much drainage of water from adjacent lands was blocked. Following heavy rains it was necessary to remove the plug and permit the surplus water to drain off. This process was repeated many times.

Opening and closing the canal was done at great expense. A dragline had to be removed from another job and brought to the site. After constructing and removing the plug several times it was impossible to find fill with which to build the plug.

During the fall of 1958 the Director of the Louisiana Wild Life & Fisheries Commission submitted a request to the Louisiana Department of Public Works for plans and specifications for a boat opening at the intersection of the Property Line Canal and the Humble Canal in order to alleviate the above problem. After these were prepared the Department of Public Works advertised for bids and the contract awarded to the lowest bidder. Construction work began in July 1959. This job will be the largest single project undertaken thus far on the refuge. The structure is a large semi-lock type and designed in a manner necessary to permit drainage, prohibit salt water intrusion, and permit the passage of boats and barges. The structure will be equipped with two electrically operated sliding gates that can be opened to a maximum width of forty feet. Construction materials include concrete, steel, and creosote-treated timber to insure maxi-

mum durability with only limited maintenance.

All phases of the work is being inspected by engineers of the Department of Public Works.

Walkways

Metal drainage culverts were placed through the levees of all nine impoundments on Rockefeller Refuge during their construction. A total of forty-two such structures exist and each is equipped with a lift gate inside the impoundment.

In order to have access to the gates wooden walkways were built from the levee to the gate. However, during hurricane "Audrey" about half of the walkways washed away, while many others were badly damaged. All walkways have been either replaced or repaired using creosote-treated sills and decking. All work on this job was done by refuge personnel.

Headquarters Area

The four relatively new buildings at the main headquarters were demolished beyond repair during hurricane "Audrey". One completely collapsed fifty feet from its foundation, one was swept away and partially collapsed one-half mile from its foundation, another remained on its foundation but was damaged beyond repair, the fourth was swept from its foundation and collapsed.

Original plans were to have the Louisiana Department of Public Works design the headquarters area, but because of an overcrowded work schedule the Department was forced to postpone this project. The Louisiana Wild Life & Fisheries Commission, realizing the need for accelerating this job agreed to hire an architect to handle the design and construction of the headquarters area. Preliminary plans were prepared by the architect and a careful



Office, laboratory and other buildings under construction at Main Headquarters, Rockefeller Refuge.

review was made by Commission personnel. After making the necessary revisions, final drawings and specifications were prepared. These were submitted to the Department of Administration and notice published asking for sealed bids. The bids were opened in May 1959, and the contract awarded to the lowest bidder.

Work on the project began in June 1959, with the clearing of the site and the driving of foundation piling.

The building layout is located on the original headquarters site. All units are east of the boat-house; the first is the office-laboratory building, next is the general quarters building, and the last two units are dwellings. All buildings are constructed in a hurricane-proof manner, that is, on piling with strongly anchored foundations, double storm sheeting, small glass windows and chipped marble roof. Other points emphasized in the designing in addition to storm proofing were economy and that the necessity of future maintenance be held to a minimum.

East End Camp Bulkhead

As a result of wave action by wind and boats in the Humble Canal, the fill in the rear of the East End Camp was gradually washing away. A temporary wooden bulkhead had been placed along the site several years ago, but this rapidly gave way and since then the site has remained unprotected.

Upon request a survey party from the Department of Public Works made preliminary surveys of the site, then plans and specifications for a new bulkhead were prepared and submitted to the Commission for approval. The necessary material for the job was purchased and in May 1959, refuge personnel, under the supervision of a Public Works engineer, began work on the project.

The bulkhead is one hundred sixty-eight feet long and constructed of twenty-seven foot interlocking steel sheet piling, having a two-foot square concrete beam along the top for its entire length.

The structure is tied back with two-inch bolts, twenty-eight feet long, which are anchored to steel H-beam piling. Thirteen such tie-backs are placed along the structure.

The bulkhead also serves as a boat dock. Wooden bumpers and boat cleats were added and all material excavated from the canal along the structure to a depth of six feet.



New concrete capped steel bulkhead at remodeled East End Headquarters Camp, Rockefeller Refuge.

Access Road

The completion of State Highway No. 292 from Grand Chenier to Pecan Island will greatly simplify management of the Rockefeller Refuge. The new highway will pass within one-half mile of the northeast corner of Lake #14, a man-made impoundment. A major patrol camp for the Vermilion Parish portion of the refuge is located on the southeast corner of Lake #14.

When the exact location of the new highway was learned refuge personnel began discussing the possibility of building a roadway to this patrol camp. Since the east levee of Lake #14, connecting the headquarters and the northeast corner of the im-

poundment, had to be repaired as a result of damages from hurricane "Audrey", it was decided to use the levee as a roadbed. By doing this over eighty percent of the roadbed has now been completed. All remaining is the one-half mile stretch to the highway.

Because of the access problem in the past it has been necessary to operate the refuge as almost two separate areas. With the new road, material, equipment, and supplies can be stored at one location and easily moved as needed.

Operation of Drainage Structures

In order to properly manage the 18,500 acres of man-made impoundments on Rockefeller Refuge a careful watch was maintained on water levels. A schedule was adopted whereby several of the impoundments would be drained each spring in order to encourage the growth of annual grasses, such as wild millet. At the same time substantial water levels were maintained in other impoundments in order to be assured of an abundance of water for the maximum production of widgeon grass and other submerged aquatics. This type of management



Lake No. 2, Rockefeller Refuge. Productive of widgeon grass, favorite food of all ducks.

assures the availability of both food and water for the early flights, as well as high quality food for ducks during the late winter. Without available water many of the early transient ducks such as gadwall, widgeon, teal, and pintails would probably move on farther south. This has happened in the past, prior to the construction of impoundments.

During May 1959 the gates on Lake #14 and Lake #15 of the Rockefeller Refuge were opened in order water levels, wild millet, cyperus, and other valuable ducks during the late winter. Without available the plants had reached a height of about six inches the gates were closed.

This type of management, which includes draw-downs as well as stabilization of water levels, proved sufficient to fulfill the requirements of all ducks. Seed eating ducks, such as mallards, pintails, and teal prefer the impoundments in which annual grasses have produced a crop of seed, while gadwall, widgeons, and certain diving ducks prefer the flooded impoundments which consistently produce

abundant crops of widgeon grass. Use by ducks has skyrocketed during recent years under this type of management on the Refuge. As evidenced by waterfowl inventories over 400,000 ducks were on the Refuge during the winter of 1958-1959.

Ryegrass Planting

Ryegrass was planted for blue geese on a sixty acre portion of the experimental area near the main headquarters of the Rockefeller Refuge. The area is encircled by a levee and was maintained in a dry condition by frequent pumping. The area was cultivated and ryegrass planted in both the fall of 1958 and 1959. A good stand was established both years and as a result a flock of about five hundred geese used the area most of the winter.

West End Drainage Structure

With the construction of the Property Line Canal, west of the Main Headquarters on Rockefeller Refuge, several natural drainage systems were intercepted and their flow diverted through the canal. The Property Line Canal is not open to the Gulf of Mexico because of salt water intrusion, consequently a drainage problem was created. In order to correct this problem plans were made to install an automatic flap gate in the canal which would permit the excess water to drain out into another canal leading to the Gulf. The flap gate will be mounted to a metal culvert sixty inches in diameter. The gate is also equipped with a lifting mechanism for cleaning. Walkways will be constructed to the structure from the levee for access.

Also a sixty inch lift gate will be placed south of the West End Headquarters building to control drainage from the west of the refuge. All work on this is being done by refuge personnel under the supervision of a Department of Public Works' engineer and will be completed in early 1960.

Experimental Ponds

The east-west levee inside the experimental area was extended to the west levee of the Bertrand Canal, thus dividing the experimental area into



Experimental impoundments at Main Headquarters, Rockefeller Refuge.

four separate ponds. A low-lift pump powered by a two-cylinder G.M. diesel engine was installed on an eight inch well in the area to provide fresh water when needed. A levee was placed inside the area to transport water from the pump to each unit individually. Also each unit can be drained individually.

All work has been completed on six one-half acre units west of the main headquarters. Each unit can be flooded or drained individually.

A refuge dragline was used to construct the experimental ponds.

Levee Repair

Since hurricane "Audrey" in June 1957, the four draglines have worked almost entirely on levee repairing and raising. Over one hundred miles of levees are in use as a part of the refuge management program. Levees are used for retaining fresh water in the nine separate impoundments and along all access canals to prevent salt water from spilling over into the adjoining marsh during high tides.



A dragline dressing a levee on Rockefeller Refuge. Over 100 miles of such levees exist on the area. Four draglines are being used in this work.

During the hurricane practically all levees were badly eroded and many were broken. The first job after the storm was emergency works, such as repairing the levee breaks. After that the slow job of dressing and raising the levees began.

The levee repair work is complete around Lake #1, Lake #3, Lake #13, Lake #15, and a portion of the levee around the remaining five is complete. Bermuda grass seeds were planted on all levees as they were completed. During the hurricane levees with the densest grass cover were damaged least.

Air Strip

The air strip on a levee inside the experimental area was extended to a three thousand foot length and eighty foot width. After the fill has set it will be graded and given a slight crest, then sodded with Bermuda grass.

The strip will be used by the Commission's aircraft for visits to the refuge and as an emergency landing field. Along the Louisiana coast very few landing strips are available.

The fill was placed for the strip using a refuge dragline.

Patrol Camps

Plans have been formulated for the construction of patrol camps in strategic locations on Rockefeller Refuge. The camps will be placed on piling and equipped with quarters and kitchen facilities.



Newly constructed patrol camp on Lake 14 at Rockefeller Refuge.

Under the Deed of Donation the Louisiana Wild Life & Fisheries Commission has the responsibility of giving the refuge full protection from hunting and unauthorized trespassing. When the camps are completed a patrol schedule will be executed with the wardens using different camps at different times. Also towers will be placed at certain camps to provide the covering of a greater area. Piling has been driven for three such camps and completion is expected in early 1960.

Weirs

Steel sheet piling, timber piling and wales were purchased for the construction of four Wakefield type weirs on Rockefeller Refuge. The weirs will be placed in strategic drainages to control water levels, tidal action and water salinities in these areas. Such structures along the Louisiana coast have proven very successful in producing waterfowl food plants in ponds of usually low productivity.

The weirs will be built south of the impoundments and will place a large portion of this marsh under ideal management.

West End Headquarters

After rebuilding the West End Headquarters Camp a refuge dragline was brought to the site and the yard raised and extended. When the fill had hardened it was topped with a layer of sand then sodded with St. Augustine grass. The entire site was then enclosed with a five foot chain link fence and a cattle guard placed in the driveway.

The garage apartment at the West End Headquarters was washed away by the hurricane. In March 1959 the garage was rebuilt using the original foundation and concrete slab. The new building is twenty by thirty feet and includes two automobile stalls and a storage room.

Water Wells

Two new water wells were drilled on the refuge and an old one re-worked. One well was put down at the new Lake #14 headquarters, and another at the Main Headquarters on Grand Chenier. Both

wells were drilled for water for domestic use. The Lake #14 well is for a water supply at the camp. The well at the Main Headquarters will serve the new buildings, work shop, and the animal pens. Water pumps and storage tanks were installed at both locations to supply the anticipated water demand.

The water output of the East End Camp well dropped off and at times would not produce. The well was reworked with acid and since has functioned properly.

Storage Area

Since hurricane "Audrey" all piling, timbers, lumber, pipe, culverts, control gates, and other material and supplies used for refuge development and maintenance work has been stored on the high fill adjacent to the boathouse. However, upon completion of the new headquarters area all of this material must be moved.

Since only a limited amount of high ground is available for storage, a refuge dragline was assigned the job of building a storage area. The area was placed southwest of the boathouse and adjacent to the levee in the northeast corner of Lake #2. Dimensions of the area are one hundred by two hundred feet with an elevation 4.5 feet above the mean water level. A building will be constructed on the area for the protection of certain materials and equipment.

Refuge Boundary Markers

As a result of the storm practically all refuge boundary markers and posted signs were destroyed along the forty-five mile portion of the refuge bordering private land. A wooden post, covered with asbestos tile, and standard refuge signs were present, prior to the storm, along the entire boundary at quarter-mile intervals. A large majority of the posts were either broken, knocked down or washed away.

All damaged or missing posts were replaced with a wooden four by four, treated post, sixteen feet long and new signs nailed on each. Also large wooden signs were erected at the mouth of all bayous leading out of the refuge. These signs list the name of the bayou and refuge, and warn against trespassing.

Fresh Water Retainer Levee

A request was submitted to the Department of Public Works for plans and specifications for a fresh water retainer levee to extend from Deep Lake to the Cameron-Vermilion Parish line and then north to the Property Line Canal. In December 1959 a survey party from the Department of Public Works completed all preliminary field work on the project.

With only a seven mile levee and three water control structures a 12,500 acre marsh area can be placed under very desirable management. The levee will serve as a retainer for fresh water entering the refuge from the north and will alleviate the necessity of dressing levees along canals inside the area.

Water control structures will be placed in the

three major bayous draining the area. The structures will be of a flap-gate type, that is, they can be closed to retain water or opened to permit water to drain out, but at the same time restrict salt water from entering from the Gulf of Mexico to the south.

After the preliminary surveys were completed on the retainer levee, the survey party began field work on the construction of an impoundment southwest of Deep Lake. The proposed area includes 5,000 acres and is completely surrounded by a levee, except for a small strip south of Deep Lake. The levee around the area will be rebuilt and the remainder completed. Water control gates will be placed in the levee at certain intervals.

Radio Facilities

A two-way radio was placed in the Lake #14 camp for coordinating work with the Main Headquarters. The radio has proven very valuable in aiding refuge patrol work. Several portable radios were purchased and will be used for communication with the base station radio or other mobile units.

Wildlife Pens

A number of wildlife pens were included in the contract to rebuild the Main Headquarters. Pens will be constructed to hold geese, ducks, alligators, and other animals collected on the refuge. The animal pens will be used as a part of the refuge research program. In addition people passing by the headquarters on the Pecan Island-Grand Chenier highway may stop and observe the captive wildlife.



Alligator eggs in a nest at Rockefeller Refuge.

Tug Boat

Because of the extensive development program on Rockefeller Refuge a tug boat was purchased for use in moving material and machinery about the refuge. The refuge has four draglines and these can be transported from one job to another only by barge. The tug is thirty-six feet long, powered with a 671 G.M. Diesel engine, and equipped with crew quarters and a galley. It is of pusher design.

Coot Banding

Every fall large flocks of coots visit Louisiana, then after staying a short while many of the birds migrate. Exactly where they go after leaving is un-



The new tug "Brant" has been very useful in moving heavy equipment and supplies to remote areas on the refuges.

known. Many coots spend a short time on Rockefeller Refuge before migrating and in an effort to gather information on their destination and movement a coot banding program was begun.

Two methods were employed for catching the birds for banding, both using marsh buggies. With one method a box trap was stationed near a large flock of coots, then wings made of four foot poultry

wire were extended one hundred fifty feet from each side of the trap. The coots were then herded together and driven into the trap with marsh buggies. For the other method photographic flood lights were mounted on the front of a marsh buggy. The buggy was then driven to a flock of coots and a man on a platform in front of the buggy scooped them up with a net.

Using these methods one hundred and twenty-eight coots were banded on the refuge. In addition several ducks and shorebirds were banded during the same operation.

Research Publications

Two technical bulletins were released by the Louisiana Wild Life & Fisheries Commission of research work done on Rockefeller Refuge. The bulletins were authored by Mr. Lewis G. Nichols, a refuge geologist, and are entitled: "Geology of Rockefeller Wild Life Refuge and Game Preserve, Cameron and Vermilion Parishes, Louisiana", and "Rockefeller Refuge Levee Study".

Copies of the publications were mailed out to Universities, public schools, public libraries, and other interested individuals.

Impoundment Ecology Study

This study was begun in 1958 to determine the effectiveness of the nine Rockefeller Refuge im-

ROCKEFELLER WILDLIFE REFUGE

WATERFOWL INVENTORY* SEPT. 1, 1958-MAY 14, 1959

DATE	Pintail	Mallard	Baldpate	Shoveller	Gadwall	B. W. Teal	G. W. Teal	Scaup	Ring Neck	Mottled & Black	Coots	Blue Geese* Snow Geese*	Total Ducks	Total Waterfowl
Sept. 3	3000	Trace	500	4000	Trace	20000	Trace	—	—	1000	500	—	28,500	29,000
Oct. 9	7500	250	4000	6000	500	25000	500	—	—	1500	10000	500	45,250	55,750
Oct. 28	45000	7500	40000	45000	55000	7500	85000	—	1000	4000	35000	15000	357,500	397,500
Nov. 10	50000	30000	25000	35000	50000	75000	80000	—	1000	3000	30000	32000	349,000	411,000
Dec. 5	100000	65000	20000	40000	85000	90000	30000	8000	2000	3000	40000	35000	443,000	518,000
Jan. 14	75000	75000	20000	25000	65000	75000	40000	15000	2000	2000	20000	35000	394,000	449,000
Jan. 28	100000	100000	20000	30000	65000	70000	35000	1000	2000	1500	15000	30000	424,500	469,500
Feb. 18	50000	50000	35000	25000	45000	60000	45000	1000	1000	2000	10000	25000	314,000	349,000
Mar. 19	5000	20000	15000	30000	40000	55000	5000	1000	1000	1500	25000	2000	173,500	200,500
April 7	Trace	Trace	2000	20000	15000	50000	6000	500	—	500	10000	Trace	94,000	104,000
May 14	—	Trace	—	250	—	2500	—	—	—	2000	500	—	4,750	5,250

*All duck and coot censuses conducted from aircraft by Morton Smith, Waterfowl Biologist—Louisiana Wild Life & Fisheries Commission. Goose inventories made from the air by R. K. Yancey, Chief—Refuge Division—Louisiana Wild Life & Fisheries Commission. Of the total number of geese: 5% were Snow Geese, 95% were Blue Geese.



Biologist examines a dense stand of widgeon grass in an impoundment at Rockefeller Refuge.

poundments. The impoundments range in size from 480 acres to 5,680 acres, and include a total area of 18,290 acres. The study will supply information on the annual changes in the vegetative composition of the impoundments and provide a basis for evaluating different management techniques.

A line transect was run through the center of each impoundment in a north-south direction and permanent markers placed and labeled along the line at one hundred foot intervals. At each one hundred foot station a five foot transect measurement was made and the vegetation present tabulated. Plant types and openings were recorded as they occurred along the transect to the nearest one-tenth foot.

Four control areas were set up south of the impoundments and sampled by the same method. The total length of the line is 74,400 feet (13.5 miles) and will be sampled annually.

Permanent stations with water gauges were set up in each impoundment and control area. The stations were visited monthly and data collected on water levels and salinity. The salinity of different impoundments varied greatly, but in general the salinity was highest in those west of the North

Island Canal. The salinity of individual impoundments increased rapidly as the water depth decreased from evaporation and transpiration. Salinities in the impoundments ranged lower than those in the control areas south of the impoundments. In June 1959 salinities in the impoundments averaged 4900 P.P.M. and at the same time averaged 6000 P.P.M. in the control areas.

In 1958 the control areas had greater vegetation coverage (55.9 percent) than did the impoundments (45.1 percent), however, in 1959 with an increase in widgeon grass (see table) the vegetative coverage of the impoundments increased to 64.4 percent, while the control areas dropped to 44.7 percent.

Wire grass, *Spartina patens*, dominated the impoundments and control areas in 1958, but in 1959, widgeon grass, *Ruppia maritima*, dominated the impoundments. Duck food producing species made up the bulk of the plants in the impoundments, however, south of the impoundments duck food plants made up less than twenty percent of the vegetation. The plants occupying these areas varied with the salinity, amount of open water depth and whether or not water was retained permanently.

TABLE NO. I
VEGETATIVE COMPOSITION OF IM-
POUNDMENTS AND CONTROL AREAS.
ROCKEFELLER REFUGE, SUMMERS.
1958 AND 1959

Plant Species	1958		1959	
	Impound- ments	Control Areas	Impound- ments	Control Areas
<i>Spartina patens</i>	28.4	77.9	26.4	87.0
<i>Ruppia maritima</i>	14.0	1.1	37.9	.4
<i>Eleocharis parvula</i>	13.5	—	5.7	—
<i>Eleocharis sp.</i>	—	—	6.4	.1
<i>Cyperus sp.</i>	2.3	1.9	.7	.9
<i>Bacopa monniera</i>	5.8	1.7	2.3	.9
<i>Pluchea purpurascens</i>	.4	.1	.1	.2
<i>Leptochloa fascicularis</i>	5.3	.2	3.6	—
<i>Aster sp.</i>	.1	.2	.1	—
<i>Scirpus robustus</i>	.8	1.7	.2	.8
<i>Phragmites communis</i>	.5	.5	.4	.3
<i>Distichlis spicata</i>	1.3	11.2	1.0	7.2
<i>Panicum repens</i>	—	—	—	.8
<i>Spartina alterniflora</i>	.3	.4	.1	.1
<i>Cynodon dactylon</i>	—	—	—	.7
<i>Sagittaria sp.</i>	3.3	.5	1.1	—
<i>Acinida alabamensis</i>	.2	.8	—	—
<i>Scirpus californicus</i>	3.8	1.1	1.2	—
<i>Scirpus olneyi</i>	—	.1	—	.6
<i>Scirpus americanus</i>	—	—	.1	—
<i>Lemna minor</i>	4.8	—	11.2	—
<i>Setaria magna</i>	.1	—	—	—
<i>Baccharis halimifolia</i>	.1	—	.1	—
<i>Najas sp.</i>	—	—	.1	—
<i>Chara vulgaris</i>	—	—	.1	—
<i>Echinochloa sp.</i>	15.0	.6	6.4	.1

Waterfowl Mortality

Botulism, an old waterfowl malady in Canada and the western United States, has finally appeared in Louisiana. Botulism is kindred to food poisoning in humans.

During early October 1959, an outbreak occurred on Rockefeller Wildlife Refuge and resulted in the loss of an estimated five hundred ducks, plus an equal number of white ibis, stilts, terns, sandpipers, and other wading birds.

Strangely enough, all losses occurred in only one of several man-made impoundments on the refuge. The infested area occupies 1,400 acres and is completely encircled by a low marsh levee. At the time of the outbreak, water depths ranged from one to six inches, salinities at 13,000 parts per million, with a pH of 8.8. This shallow, alkaline water condition is reported to be favorable to *Clostridium botulinum*, the bacteria that produces the toxin so poisonous to animal as well as bird life.

On October 7, employees of the Louisiana Wild Life & Fisheries Commission first realized that an unusual die-off of waterfowl was in progress on the refuge. Sick and dead birds were picked up with a marsh buggy and then examined in an effort to determine the cause of the deaths. After field studies proved fruitless, several birds were sent to the State Diagnostic Laboratory, while others were sent to the Louisiana State University School of Veterinary

Science, and to a private veterinary firm in Lake Charles. At the same time, consultations were held with Dr. Leslie Glasgow, Professor of Wildlife Management at L.S.U., John Lynch, Flyway Biologist for the U. S. Fish & Wildlife Service, and several additional biologists for the Louisiana Wild Life & Fisheries Commission. Preliminary analysis indicated that algae was causing the problem, however, final studies proved that botulism was responsible. Symptoms for the two are very similar but blood samples, examined by the U. S. Fish & Wildlife Service at Denver, showed positive for botulism, according to John Lynch.

Although the cause was not determined early during the die-off, it was obvious to all who were called in for advice that a toxin was present in the impoundment and that it should be cleared out as soon as possible. On the evening of Saturday, October 10, 1959, approximately 20,000 ducks were observed coming into the lake to roost. This concentration was dispersed by means of a marsh buggy and the following day the levee was cut by means of a drag-line in order to drain the impoundment through a tidewater canal leading directly to the Gulf of Mexico. Mudboats were used to drive ducks from the area on the 11th, and on the 12th, an airboat was rented to assist in this effort. Substantial rainfall occurred over the week-end and aided in flushing the impoundment through the openings in the levee. In addition, high tides in the canal shifted an abundance of water into the lake and as tides dropped the surplus water drained out into the Gulf. By October 15 it was obvious that the duck die-off was over as a result of the corrective action that had been taken.

Most of the ducks that were lost were mottled ducks and shovellers, although a few blue-winged teal and pintails also died. Many waterfowl die-offs have occurred in Louisiana in the past, but this was the first time that corrective measures were successfully employed. Fortunately, this problem was situated so that something could be done or a die-off of great proportions may have resulted. Much was learned during this period and we hope to profit from this experience in the event of another outbreak in the future.

Canal Erosion Study

In May 1958 a survey was conducted to determine erosion rates along the canal banks used to service existing oil and gas fields on the refuge. It was found that erosion is a serious factor to consider when planning the development of a mineral lease on this area.

In the development and operation of existing leases, canals were excavated in order to reach drilling sites. Following the successful completion of wells, cabin cruisers varying in size from 25 feet to 35 feet, were used in the canals to service the operations. These boats make one to several trips daily and the resulting wave wash brought about erosion of the canal banks.

It was found that the Humble Canal widened at the rate of 1.16 ft. per month since September, 1954. At the same time the Superior Canal widened at the rate of from 1.22 ft. to 1.64 ft. per month. These

canals were dredged out originally to a width of 60 and 65 ft. but now vary in width from 110 to 158 ft. This represents an increase of 243 per cent along some of the canals. In order to reduce this rate of erosion traffic in the canals has been scaled down considerably, however, this will not solve the problem. It was found that complete control cannot be exercised through earth work alone and other construction procedures, such as bulkheading, are not economically feasible.

MARSH ISLAND WILDLIFE REFUGE

HARVEY H. LOURD
Refuge Manager

ROBERT H. CHABRECK
Biologist

Headquarters Area Bulkhead

Plans and specifications were prepared by the Louisiana Department of Public Works for a 750 foot bulkhead along the portion of the headquarters area bordering Bird Island Bayou. Construction materials were purchased by the Louisiana Wild Life & Fisheries Commission and included creosote treated four inch by ten inch center match sheet piling, twenty feet long and six inch by six inch wales.

Construction work began on the bulkhead in August 1958, and by December 1958 all sheet piling had been driven. A wale was placed on both sides of the sheet piling and secured with three-quarter inch galvanized bolts.

In January 1959 work began on the boat dock and wharf in front of the main camp on Bird Island Bayou. The boat dock was constructed to avoid the necessity of digging out in front of the bulkhead.

Most of the backfill for the bulkhead was crushed oyster shells excavated from the beaches on the refuge. The oyster shells were placed behind the bulkhead, and present plans are to purchase washed clam shell to use as a dressing on the backfill.

A six-piling cluster was placed at each end of the wharf to prevent possible damage from incoming boats and barges.

All work on the bulkhead and wharf was performed by refuge personnel under the supervision of an engineer from the Department of Public Works.

A sixty foot bulkhead was placed south of the refuge boathouse and will facilitate the loading and unloading of two 1000-gallon butane storage tanks. Materials used for this job was the same as that for the other bulkhead.

Boat House

All contract work on the Marsh Island boathouse was completed in June 1958. The fifty by sixty foot metal structure has two separate boat stalls, surrounded on three sides by walkways, and a twenty

For this reason plans are being made to require that future mineral lessees construct roads in their development and operation instead of canals. Such requirements as this will be written in as part of the lease in order to prevent damages to the area as a wildlife refuge and conform to terms and conditions set forth in the Deed of Donation under which the State received this property from the Rockefeller Foundation.



A portion of the 750 foot bulkhead at the Marsh Island Refuge headquarters. Note the metal boat house - workshop - to the rear of the Main Camp.

by fifty foot work area in the rear. A platform was placed above storm tide levels in the work area to house the headquarters 110-volt generating plant.

Two heavy duty hoists were mounted on an I-Beam above one of the boat stalls. Both hoists are equipped with slings and are used to raise the large refuge boats for minor repair and maintenance. The boats can be raised with the hoists, then conveyed with the I-Beam and trolleys to the work area.

A twenty by twenty foot storage room was constructed on one side of the work area and will be used to house equipment and material such as outboard motors, propellers, oil, paint, parts, and other supplies.

All phases of the contract work was completed under the careful inspection of an engineer from the Department of Public Works.

Weirs

Refuge personnel, using a refuge dragline, constructed seven Wakefield type weirs in bayous on Marsh Island Refuge. Four weirs were constructed with interlocking steel sheet piling and the others with center-matched wooden four by ten creosote treated sheet piling.



Refuge personnel building a steel weir in Scat Bayou, Marsh Island Refuge.

Three of the steel weirs were constructed in the spring of 1958 in strategic drainages on the east end of the island. A marsh area of 6,300 acres was improved by these weirs.

One weir was placed on the north branch of Worm Bayou, west of Lake Tom. The total length of this weir is one hundred twenty two feet. Another was placed in Bayou Scat No. 2, which drains into the south end of Lake Michael, and its length is eighty-

eight feet. The third steel weir was built on Bayou Scat No. 1, near its entrance to Bayou Blanc and has a total length of one hundred and eight feet.

The remaining four weirs were constructed in tributaries of Bird Island Bayou in the spring and summer of 1959.

One steel weir was placed along Bird Island Bayou to prevent the reverse flow of water from behind the Worm Bayou weir. In addition to accomplishing this objective, an additional 1,100 acres of marsh was improved.

The three wooden weirs were placed in small bayous and averaged fifty feet in length.

One was placed in a small bayou one-quarter mile southwest of the headquarters camp, another placed one and one-half miles south of the headquarters, and the third in a small bayou leading north from



Tongue and groove sheet piling was used to construct several low water weirs on Marsh Island Refuge.

MEAN MONTHLY AND ANNUAL WATER LEVELS* BEHIND WEIRS AND IN CONTROL AREA. MARSH ISLAND

MONTH	BEHIND WEIRS					CONTROL AREA				
	Mean High Tide	Mean Low Tide	Mean Water Level	Highest Individual Tide	Lowest Individual Tide	Mean High Tide	Mean Low Tide	Mean Water Level	Highest Individual Tide	Lowest Individual Tide
January	.85	.67	.76	1.5	.5	.39	-.35	.02	1.5	-2.0
February	.91	.74	.83	1.4	.5	.56	-.26	.15	1.6	-1.8
March	.88	.71	.79	1.2	.5	.60	-.18	.21	1.3	-1.5
April	1.03	.83	.93	1.0	.5	.78	.09	.43	1.2	-.7
May	1.07	.82	.94	2.3	.5	1.13	.40	.76	2.4	-.7
June	1.04	.80	.92	1.5	.5	1.19	.18	.69	1.7	-.7
July	.74	.59	.66	1.3	.5	.83	-.06	.39	1.5	-1.0
August	.86	.68	.78	1.3	.5	.83	.11	.47	1.6	-.8
September	1.37	1.16	1.26	2.6	.6	1.26	.69	.97	2.6	-.2
October	1.11	.90	1.01	1.7	.5	1.06	.39	.72	1.8	-.5
November	1.03	.80	.91	1.4	.5	.85	.07	.46	1.5	-2.1
December	.76	.64	.70	1.1	.5	.37	-.62	-.12	1.4	-2.2
Mean										
Annual Tide	.97	.78	.87			.82	.04	.43		

*Data collected with continuous recorders from July 1958 until July 1959.
Tidal readings listed in feet

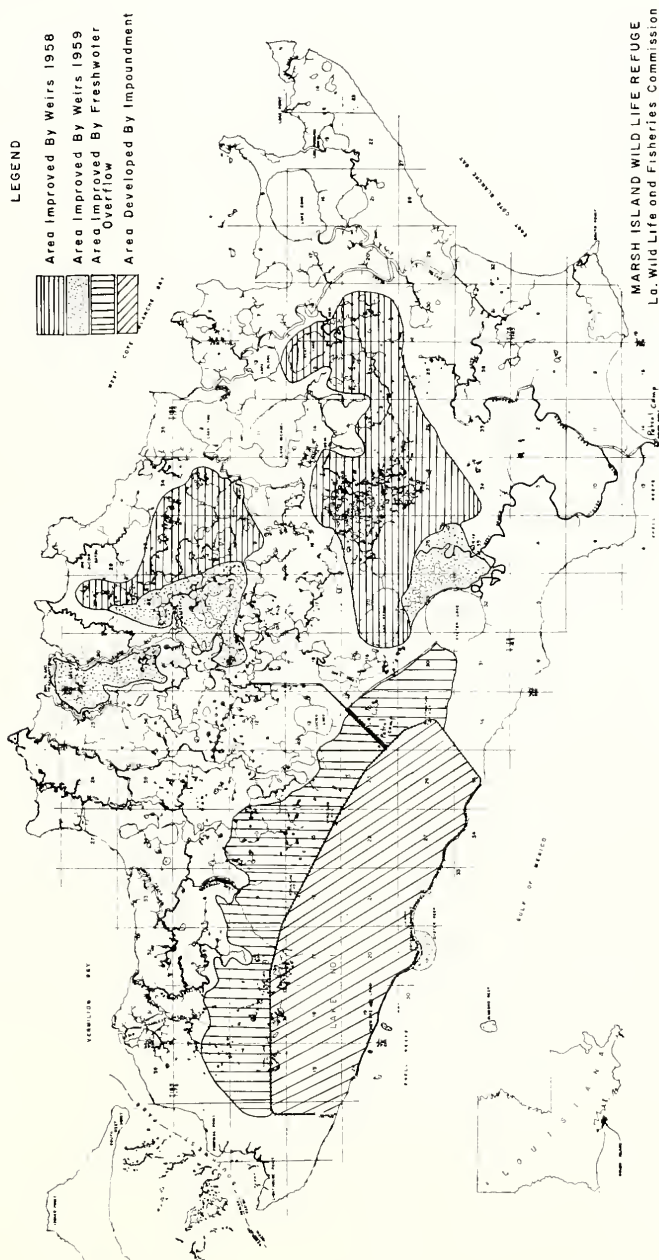
Oyster Bayou, three-quarters of a mile east of Oyster Lake. These three structures affect an area of 1,500 acres.

The crests of all weirs were set at an elevation six inches below marsh level. The wings of the weir were extended into the bayou banks for an average of twelve to fourteen feet.

As a management procedure the weirs will par-

tially stabilize water levels, reduce tidal action, minimize water turbidity, and reduce or stabilize water salinities. All weirs combined improve an area of 8,900 acres.

Present plans are to continue the weir building program on the refuge. Special emphasis will be placed on the west half of the island in the future planning.



Levee Repair

As a result of hurricane "Audrey" the levee forming the 8,000 acre Marsh Island impoundment was badly damaged. In general the levee was damaged by several bad washouts.

Original plans were to have the refuge dragline rebuild the levee. But with many other jobs to do, plans and specifications were prepared for the job by the Department of Public Works. Bids were solicited through regular advertisement channels and a contract for the job awarded to the lowest bidder. The contract called for repairing only the portions of the levee below a five-foot elevation which was established and marked by an engineering survey.

Impoundment Drainage Structures

All contract work on the installation of five metal culverts in the Marsh Island impoundment levee was completed in April 1959. The culverts, measuring seventy-seven inches by forty inches (oval shaped), were equally spaced along the north levee of the impoundment. Each culvert is equipped with a gate which can be lifted to drain the area or serve as an overflow structure.

All phases of the work on this project was carefully supervised by an engineer of the Louisiana Department of Public Works.

Patrol Camp

Thirty-four small refuge camps were destroyed as a result of hurricane "Audrey". These camps were scattered throughout the island and used for patrol work and trapping.

Plans were made to rebuild several of the camps, particularly those in strategic locations. One camp was built on Oyster Bayou at Mound Point and will provide patrol coverage of the southeast corner of the refuge. Another was placed on the high levee where the Bird Island Canal meets the 8,000 acre impoundment.

All camps will be placed on piling to insure against any future storm damage and will be equipped with quarters and kitchen facilities. Patrolmen will be rotated to these various camps to insure against violation of refuge regulations.

An attempt will be made to salvage the ten artesian wells on the refuge. These wells provide the only source of drinking water on the island. In recent years the wells have deteriorated so badly that several have stopped flowing and the pipe rusted off at the ground level on others.

Old Headquarters Camp

Original plans were to transfer the old headquarters from its location on Bird Island Bayou to Bayou Chen, but after checking the costs and advantages of this project it was found that this would not be economically feasible. The camp was then put up for sale and public notices published asking for bids. The bids were received and the camp sold to the highest bidder.

The entire camp was torn down and removed from the refuge by the buyer.

Dove Banding

As part of a cooperative project a dove banding station was set up on Marsh Island Refuge. Similar stations were set up elsewhere along the Louisiana coast in an effort to gather data on the movement of these birds. At certain times of the year large flocks of doves make their way along the coast and their exact destination is yet unknown.

Doves were trapped and banded by refuge personnel under the supervision of refuge biologists. Banding stations were set up at the headquarters area and on Chenier la Croix. A total of one hundred and fifty doves were banded during this operation.

Research

A greatly expanded research program has been carried out at Marsh Island in the past two years in order to provide a sound basis for development work. This job has been carried out by three trained biologists, two of whom have M.S. degrees in wildlife management from Louisiana State University.

Study of Marsh Improvements

This study was begun in the spring of 1958, following the construction of three Wakefield type weirs in strategic drainages on the east end of Marsh Island Refuge. The area was sampled at six-month intervals after this date. The primary purpose of the study was to evaluate the effects of the weirs on the enclosed marsh and marsh ponds to determine the salinity, turbidity, and water level changes behind the weirs. A control area was set up near the weirs and sampled, using identical techniques for the purpose of comparison.

Vegetation in ponds was sampled by running two lines across each pond and then checking a certain number of stations on each line. Plant species and density were recorded at each station. Marsh vegetation was sampled by means of line transects. Water samples were taken in each pond and analyzed for salinity and turbidity.

PERCENTAGE FREQUENCY OF AQUATIC VEGETATION IN CERTAIN PONDS ON MARSH ISLAND REFUGE PONDS AFFECTED BY WEIRS*

PLANT SPECIES	Before Weirs Constructed Spring, 1958	6-Months Afterward Fall, 1958	12-Months Afterward Spring, 1959	18-Months Afterward Fall, 1959
<i>Ruppia</i>				
<i>naratima</i>	18.0	12.6	8.0	13.0
<i>Vallisneria</i>				
<i>spiralis</i>	1.4	1.9	.9	1.1
<i>Eleocharis</i>				
<i>parvula</i>	.9	—	—	—
<i>Ceratophyllum</i>				
<i>demersum</i>	—	.3	.6	.3
Total	20.3	14.8	9.5	14.4

CONTROL PONDS

<i>Ruppia</i>				
maratima	18.0	2.6	8.3	2.9
<i>Vallisneria</i>				
spiralis	.3	.3	1.0	.1
<i>Eleocharis</i>				
parvula	.6	.6	.6	—
<i>Ceratophyllum</i>				
demersum	—	—	—	—
Total	19.9	3.5	9.9	3.0

*Weirs constructed in April, 1958

Salinities decreased in the entire study area after the weirs were constructed and continued to decrease until after the spring of 1959. In the ponds behind weirs and in the control ponds the salinity remained approximately the same, beginning at 3500 P.P.M. and decreased at about the same rate. Then in the fall of 1959 salinities increased to 5000 P.P.M. in both areas. But even then the salinities were about the same. The salinity of the study area is greatly affected by the flood stage of the Atchafalaya River and the low river stages during the summer of 1959, after a long period of above-average stages, probably caused the salinity increase.

The water turbidity in ponds affected by weirs was slightly lower than that of the control ponds each time checked, except before the weirs were constructed. In all cases, except one, the water turbidity during the spring was greater than that of the fall of the same year.

As shown in included table, water levels averaged

slightly higher behind the weirs than in the control area, however, water level fluctuations were much greater in the control area. The crest of the weirs were set at elevation 0.5, consequently the water level behind them could only recede to this level.

During the time that the weirs were under construction the percentage frequencies of aquatic vegetation in ponds behind weirs and in the control ponds were very similar (see table). The percentages then decreased in both areas, however, behind the weirs the decrease was much less than that in the control area. The data also shows a considerable difference in the seasonal production of aquatics in both areas. During the spring of 1958 and 1959 the percentage frequencies for ponds affected by weirs and the control ponds were almost identical. But, by the fall of both years a drastic change had occurred and the percentages for ponds behind weirs were almost four times those of ponds in the control area. The figures for individual areas also showed marked similarity between the fall of 1958 and the fall of 1959.

Little difference was noted in the vegetative changes between the marsh area affected by weirs and the control marsh area one year after the weirs were constructed. In both areas wire grass, and black rush, *Juncus roemerianus*, decreased, while three-cornered grass, *Scirpus olneyi* increased. The degree of change for both areas were similar.

In the well-drained marsh affected by weirs a number of new species appeared which were not present on the transect the year before.

It is the opinion of the writer that favorable

MARSH ISLAND WILDLIFE REFUGE WATERFOWL INVENTORY*

Oct. 9, 1958—May 14, 1959

DATE	Pintail	Mallard	Baldpate	Shoveller	Gadwall	B. W. Teal	G. W. Teal	Scaup	Mottled & Black	Coots	Blue Geese* Snow Geese*	Total Ducks	Total Waterfowl
Oct. 9	2000	—	2000	4000	—	10000	500	—	200	1000	—	18,700	19,700
Oct. 28	4000	3000	4000	7500	10000	10000	500	—	250	8000	17500	39,250	64,750
Nov. 10	7000	20000	7000	8000	15000	15000	10000	—	250	15000	60000	82,250	157,250
Dec. 4	12000	15000	5000	10000	25000	12000	5000	—	300	10000	85000	84,300	179,300
Jan. 13	3000	10000	7500	15000	12000	7000	5000	—	200	20000	85000	59,700	164,700
Jan. 28	3500	15000	5000	20000	15000	7500	4000	5000	200	15000	50000	75,200	140,200
Feb. 18	1000	5000	2000	12000	7000	7500	1500	—	100	7500	30000	36,100	73,600
Mar. 19	—	250	2000	10000	15000	7000	1000	100	100	7000	Trace	35,450	42,450
April 7	—	100	1000	7000	10000	15000	—	—	100	10000	Trace	33,200	43,200
May 14	—	—	—	100	—	500	—	—	100	1000	—	700	1,700

*All duck and coot censuses conducted from aircraft by Morton Smith, Waterfowl Biologist—Louisiana Wild Life & Fisheries Commission. Goose inventories made from the air by R. K. Yancey, Chief—Refuge Division—Louisiana Wild Life & Fisheries Commission.

Of the total number of geese: 5% were Snow Geese, 95% were Blue Geese



Blue Geese in flight over Marsh Island.

marsh conditions existed in the study area at the time that the weirs were constructed and the full effectiveness of the weirs cannot be tested until unfavorable conditions threaten.

Waterfowl Inventory

During the winters of 1958 and 1959 periodic aerial inventories were made of the waterfowl populations on the refuges using an aerial transect method. The results of the inventories are shown in the included tables.

Nutria Exclosure Study

This study began in 1955 with the construction of a thirty by thirty-four nutria exclosure along Bird Island Bayou on Marsh Island Refuge. The following year similar exclosures were built on Marsh Island, State Wildlife and Rockefeller Refuges.

All exclosures were built with five foot chain-linked fencing and buried to a depth of one foot. The exclosures were sampled annually using line transects and quadrants. A control area was set up outside of each exclosure and sampled by the same methods.

In most cases the vegetative composition of individual nutria exclosure was very similar to that of the adjacent control area. Annual changes in a certain species was usually reflected in both the exclosure and the control.

In general, the exclosures were more densely vegetated than the control areas. The averages revealed that the exclosures contained forty percent more vegetation than did the control areas. Annual increases and decreases in the percentage of the exclosures vegetated were matched by a similar in-

crease or decrease in the control area. Although the marsh was opened up to a degree by nutria activity, no specific case could be termed as an "eat out". Nutria are mainly surface feeders, although they may dig at times for shallow roots. Consequently, marshes subjected to a high nutria population recovered soon after the population decreased and the pressure on the marsh lessened. By the end of the first year after the exclosures were constructed, the marsh had recovered to the same degree as it had four years after the exclosures were constructed.

Stem counts on three-cornered grass *Scirpus olneyi*, leafy three-square *Scirpus robustus*, and hog cane *Spartina cynosuroides* revealed considerable differences in their response to nutria activity. In no case was a species eliminated from an area by nutria. However, in all cases three-cornered grass and hog cane were much denser in the exclosures than in the controls. This was probably a direct effect of nutria activity. In general, leafy three-square was slightly denser in the exclosure; however, there were exceptions. Other factors seem to have a big influence on this plant. It appeared and disappeared each year in certain areas without any continuity. The effect of nutria's feeding on this plant was practically insignificant.

Very little plant succession occurred within the exclosures that did not occur in the controls. Although the vegetation became denser in the exclosure, the composition of both areas remained basically the same with one exception. Inside most exclosures wire grass, *Spartina patens* gradually increased and salt grass, *Distichlis spicata* gradually decreased. The nutria's preference for the former may have been partly responsible for this.

WATER POLLUTION CONTROL DIVISION

KENNETH E. BIGLANE

Chief



KENNETH BIGLANE

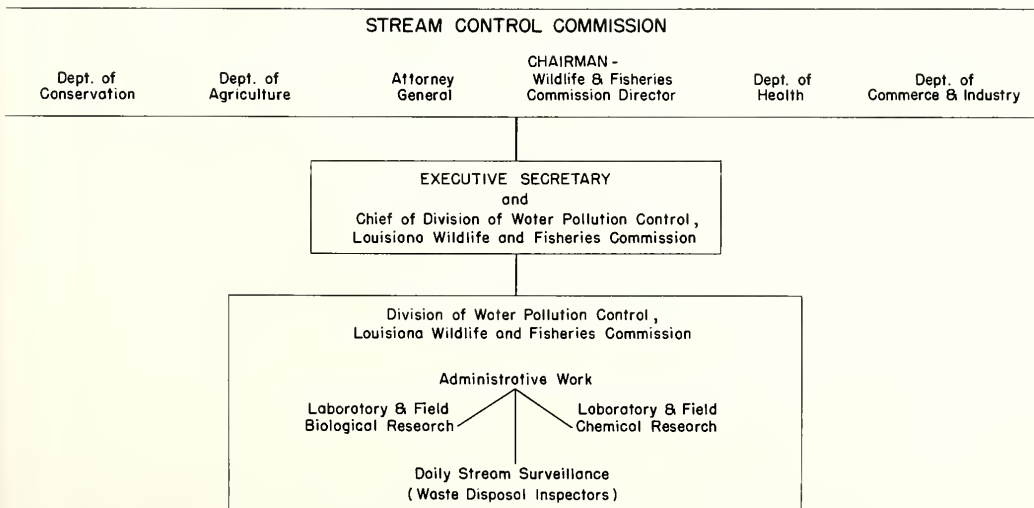
The Division of Water Pollution Control's primary duty is to supply the technical, scientific, and enforcement needs of the Louisiana Stream Control Commission, the water quality authority for the State of Louisiana. Many people do not realize that upon these two groups rests the grave responsibility of maintaining the purity of water for Louisiana's domestic, recreational, industrial and agricultural users. In order to depict the close relationship and liason between the Commission and the Division the following chart is offered.

Because the Stream Control Commission is an ex-officio board, the continuity of program is carried on between meetings by the Division of Water Pollution Control. The Commission has no legislative appropriations and therefore has to depend on those state monies obtained for the Division of Water Pollution Control by the Wild Life and Fisheries Commission and federal funds obtained through

Section 5, P. L. 660, 84th Congress. This latter named source of revenue began in 1956, and is continuing up to this point. Unfortunately, this federal program has come under heavy attack at each session of Congress and just how long these funds will be granted is a matter for conjecture.

The Stream Control Commission's authority and membership may be found in the Revised Statutes of 1950, Title 56, Sections 1431-1445. It is noted that the Commission has control of waste disposal,

ORGANIZATIONAL CHART WATER POLLUTION CONTROL AGENCY STATE OF LOUISIANA



public or private, by any person, into any of the waters of the state or any tributaries of drains flowing into any of such waters, for the prevention of pollution. The Commission can also establish such pollution standards for waters of the state in relation to the public use. Enforcement of these standards are relegated to the agents and enforcement officers of the Commission of Wild Life and Fisheries but the Attorney General has charge of and prosecutes all cases arising out of violations of these sections.

Although this report is supposed to cover a two year period only, it is believed that a review of the enforcement actions of the Commission and the Division is worthy of note for the period 1950-1959. In reviewing the official minutes from board meetings, it was learned that the Commission has issued over 160 orders against individual industrial concerns that were affecting our state waterways. Table I, below, depicts those type industries receiving these orders.

TABLE I
ORDERS ISSUED TO LOUISIANA
INDUSTRY TO ABATE POLLUTION,

1950-1959			
Type Industry	No. of	% of	
Oil	Orders	Total	
a. Production	77	47.2	
b. Refining	1	0.6	
c. Transportation	1	0.6	
Sugar Mills	72	44.2	
Sweet Potato Plants	6	3.7	
Other (including paper mills, Naval stores, other food processors)....	6	3.7	
Total	163	100.0	

As can be seen the largest number of orders have been issued to the oil producers. This is not surprising because their greatest period of activity has been recorded in this ten year span. In 1953, there were 556 oil and/or gas fields producing over 700,000 barrels of oil per day. In 1959, the number of fields had risen to 934 and had a daily oil production of over one million barrels. Polluting wastes from oil producing operations fall into the following categories.

- Oil field brines
- Waste oil and oil base drilling muds
- Toxic chemicals used in separating oil and water, corrosion prevention, and caustic compounds used to make up drilling muds.

Oil scouting procedures such as explosions from seismic operations have also been a source of complaints along the coastal and offshore areas.

Oil field brine production from stripper fields in Central Louisiana were measured for the second time by a Division survey crew headed by D. B. Reed, Engineer II. The results of this survey and a similar one conducted in 1953 are shown in Table II:

TABLE II
OIL & OIL FIELD BRINE PRODUCTION
FROM THE TULLOS-URANIA OIL FIELDS

Year	Brine Discharges in barrels/day	Daily Oil Production in barrels/day	Percent Brine Production
1953	174,335	1974	98.87
1959	174,626	2123	98.79

The Division enlisted the help of the Louisiana Geological Survey to determine if these brines could be feasibly disposed of by underground injection. Table III depicts a report from the geologists with this group submitted on April 28, 1959, showing the following data:

TABLE III
TULLOS-URANIA AND GEORGETOWN
FIELDS, TOWNSHIPS 9 AND 10 NORTH,
RANGE 1 AND 2 EAST, GRANT LASALLE
AND WINN PARISHES

Base of fresh water	@ 600 feet
Middle of Sparta Sand	@ 900 feet
Base of Sparta Sand	@ 1200 feet
Top of Wilcox sand	@ 1500 feet

The report further states that: "The Wilcox is approximately 2300 feet thick in this area and it consists of lenticular sands and shales. There are numerous sands in the Wilcox which carry salt water and are suitable for disposal of salt water. If these sands are used for salt water disposal, there will be no danger of polluting fresh water sands."

Armed with the following data, the Division recommended to the Stream Control Commission that a hearing be called and that the necessary actions be initiated against those producers causing the pollution of the Little River Watershed.

1. An investigation entitled "A Biological and Chemical survey of the Little River System, Grant and LaSalle Parishes, Louisiana, June 1952 through September 1953," by K. E. Biglane, then Aquatic Biologist.
2. A 1953 and a 1959 assay of oil field brines produced in the Tullus-Urania, Georgetown, Selma, Summerville, and Little Creek Oil Fields, by D. B. Reed, Engineer.
3. A report of investigation from the Louisiana Geological Survey, April 28, 1959, demonstrating the feasibility of returning these brines to underground formations.

The Commission then acted by calling a hearing on July 21, 1959. To our dismay, the hearing was postponed and the pollution is still occurring. This action was not precedential however, for a similar hearing was called and postponed in December, 1954. I wish to emphasize at this point that the Louisiana Stream Control Commission had carried the issue to a point where it no longer had full control of those actions that caused the matter to

be deferred.

Let us explore for a moment the real issues behind this very controversial case and see if a fair and unbiased solution can be found. The problem began about 40 years ago when the Tullios-Urania oilfield was first produced. At that time there were no laws in oil conservation and these fields were furiously pumped. During this same time there were also no laws prohibiting the discharge of oil field brines and consequently the owners of those wells were not forced to ground inject these pollutants even though they could well afford to have done so. As time progressed the brine production increased until now the percentage of brine has risen to over 98 percent of the total fluid produced and has remained at this rate during a recorded six years. The Tullios-Urania Field has 116 producing wells operated by 38 individual or major-company interests. The Stream Control Commission's Order called for oil field brine discharges according to river gauge heights only. During low flow periods of the river this would mean withholding 90 percent of the 174,626 barrels per day now being produced. Underground injection therefore, is the only sure means by which this could be accomplished. The cost of implementing and maintaining injection systems have been offered as the main reason for the resistance offered by operators in these stripper fields. They allege that this action would mean the death by abandonment of an industry in an area of the state that can ill afford to lose a source of revenue.

Apparently the resident citizens in and around these communities are of the same opinion for they have shown resentment toward the issuance of any restrictive orders to the oil operators.

No state governmental agency desires to work toward the detriment of any community or communities within the states. On the other hand, *ours is an enforcement task and one way or another this task must be completed*. A situation such as this, if allowed to continue, will affect water control policy within this state to a serious degree. Not only will it become increasingly harder to curtail instances of real or potential oil field brine damage, but these Tullios-Urania type problems have in the past and will continue to invite federal intervention into those laws which should be each state's responsibility to enforce. In this writer's opinion, the entrance by the federal government into this phase of state government might:

1. Eventually lead to a dual set of water quality standards—one set utilized by the state and one utilized by the government.
2. Create an atmosphere of tension and indecision within our own state industry, the majority of which has looked to the State Stream Control Commission for guidance on water quality problems.
3. Lose the spirit of cooperation on water quality problems that now exists between this agency and the majority of state industry.

During the 1958 session of Congress there was a bill offered (HR. 86-8494) which would have amended the Federal Water Pollution Control Act

of 1956 to extend the jurisdiction of the present federal enforcement procedures from pollution of *interstate* waters to *all navigable* waters in the United States. In Louisiana the courts have held that, "a stream is navigable in law when it is navigable in fact."

This writer has offered objections to this bill both to the author and to members of our congressional delegation. It has been our experience to note that all of these difficult problems must be met with three equally important and interdependent instruments. They are: *Widespread public opinion, research, and enforcement*. In the Tullios-Urania case there has not been enough widespread public opinion against the pollution and there has not been enough research on the part of industry to come up with more economical measures of abatement. Enforcement, in this instance, could not stand alone as being the total answer. We may find temporary solace in turning over such a problem to the federal courts, but as scientists we believe there is an answer to the problem which will serve all interests.

Justification for this belief stems from the long hard struggle to eliminate stream pollution in the raw sugar cane processing areas of the state. For many years the waters of Bayou Teche, Lafourche, and certain other streams in the cane growing parishes of Louisiana had been affected by the thousands of gallons of sugar mill discharges which contained entrained raw sugars, muddy cane wash water, floor sweepings, filter press muds, sludges from boiler blowdown, acids, alkalies, and pieces of leaves and cane stalks.

Researching on the best method of abatement was started by this Division back in the 1940's. The Sugar Engineering School of Louisiana State University started similar researches thereafter and it soon became evident that a solution could be found. Before the problem was solved the three essential elements of pollution enforcement had all been utilized.

1. *Widespread public opinion*: The citizens living in and around the cane processing areas held public meetings to protest this annual nuisance that was depreciating property values, contaminating water supplies, causing public schools to be interrupted because of obnoxious odors arising from the water, killing fish, and the general demoralizing effect that grossly polluted water has on the civic pride of most citizens. Wild life clubs, all news media, and Police Jurors began to demand that something be done about the situation.
2. *Research*: There is no doubt in this writer's mind that any state industry is desirous of hurting any of the state's natural resources, particularly water resources. There is reason to believe, however, that many industries do not know what to do or how to go about solving their pollution problems. There is also the fact that many industries, particularly those with large volumes of discharge to treat, cannot economically install those devices or techniques that are required to remove the

waste loads causing a stream pollution. If such an industry is faced with one or both of these problems, then it is *inexcusable for this group to bide behind and utilize these facts as a justification for their continuous degradation of Louisiana's water resources.* In the case of Louisiana's sugar industry, those techniques that could salvage more sugar from the waste discharges were researched upon by this Division, individual mills, and Louisiana State University. At the same time this Division and the Stream Control Commission determined those harmful components that must be withheld from state streams and instructed the sugar industry as to the proper method of impounding and length of time for impoundment.

3. **Enforcement:** Orders were issued to every state mill contributing to this annual pollution after certain methods of sugar recovery were found to be economically feasible and practical to install, and after the Division had determined what components of sugar house wastes must be withheld. These orders were reasonable and they were enforced beginning in 1955. The following Table IV indicates the pounds of BOD (waste) removed from a short stretch of Bayou Teche since 1954 as a result of these orders.

TABLE IV
POUNDS OF BOD FROM SUGAR MILL
DISCHARGES TO BAYOU TECH BETWEEN
BREAUX BRIDGE AND FRANKLIN, LA.
IN 1954 AND 1958.

	1954	1958
Tons/Day Cane Ground.....	13,550	11,200
Average BOD/Day	176.0	80.4
Total lbs. BOD/Day.....	57,024	19,969
Average lbs. BOD/ton/Day.....	4.21	1.78

It is noted from the above Table IV that over 35,000 pounds per day of BOD has been removed from Bayou Teche as a direct result of these procedures. Each entity was essential for this particular abatement program. This industry's activities during 1958 and 1959 will be further discussed by the Assistant Division Chief elsewhere in this section.

TECHNICAL INVESTIGATIONS

Robert A. Lafleur, Assistant Chief
Dr. Richard T. Gregg, Biologist
Louis R. Kuss, Chief Chemist
Charles R. Allor, Chemist
James S. Mathis, Chemist

A subject of great national and state concern is that regarding the status of our natural resources. One of these resources, water, the greatest resource present in the State of Louisiana, continues to increase in importance as more individuals realize the great potentials afforded by our many waterways; still others realize the tremendous loss which can

result if our waterways were rendered unfit for consumption, navigation, recreation or industrial use.

During the early years of this century it became quite obvious that some satisfactory method or methods were needed to dispose of various amounts of waste matter, both domestic and industrial. The most acceptable procedure at that time was to dilute the waste material in natural waters. However, due to tremendous increases in population and the development of fantastic industrial complexes, it was soon realized that this "dilution method" was quite inadequate. These relatively uncontrolled and uncoordinated efforts, whether due to a lack of technical knowledge or economic restrictions, resulted in the near destruction of the usefulness of some waters for municipal, recreational, agricultural and industrial purposes. This aroused a public demand for an agency or commission capable of and equipped for eliminating the gross contamination of our streams.

The State of Louisiana, in response to public demand has placed the responsibility of sampling and conducting both chemical and biological analyses of its many waterways to the Division of Water Pollution Control, a Division of the Wild Life and Fisheries Commission. This organization has been built around a hub, the laboratory, which is located in the Geology Building, situated in the heart of the Louisiana State University campus in Baton Rouge, Louisiana. The principle function of this laboratory is to conduct various chemical and biological tests on all samples submitted to this organization by investigating teams from this office, Waste Disposal Inspectors, individual citizens, and many industries.

The staff of this laboratory, which includes, biologists, bacteriologists, chemists, biochemists, and engineers, interprets and evaluates the data obtained from these tests in conjunction with all other known factual information. The conclusions and recommendations of this scientific group are then disseminated to the individual or industry concerned.

Generally, the three major questions confronting this organization are:

- (a) What effect will the discharge of a given volume of a specific waste product have upon the physical, chemical and biological properties of a stream?
- (b) What type of corrective treatment is necessary before said waste can be discharged into a stream?
- (c) How long will it take a given stream to recover from the discharge of this waste.

A second function of the laboratory, which is of equal importance, is the accumulation of Base Line Data from the major waterways of the State of Louisiana. This subject of Base Line Data will be more fully explained in another portion of this report.

During this past biennium, thousands of samples have flowed into this hub in Baton Rouge for various types of analysis. Some of the types of industrial wastes studied are as follows:

- (a) "White Water" and wash and process waters

- from pulp and paper mills.
- (b) Meal waste and wash water from cottonseed products mills.
- (c) Washing and rinse water from laundries.
- (d) Influent and effluents from septic tanks.
- (e) Wash waters, spoiled fluids, and paunch contents from slaughter-houses.
- (f) Process and wash water from canneries and food processing plants.
- (g) Process and wash water from sugar mills.
- (h) Process water from naval stores.
- (i) Acid or alkaline wastes from chemical industries.
- (j) Brine wastes from petroleum fields.
- (k) Sulfur containing waters from mining operations.
- (l) Toxic wash waters and liquors from metal plating and chemical industries.
- (m) Silty residues from washings in gravel pits.
- (n) Tarry and oily residues from petroleum industries.
- (o) Phenolic wastes from petroleum and chemical industries.

From the above enumeration of materials received by the laboratory it can readily be seen that industry may introduce into our waters organic or inorganic wastes in either a dissolved or particulate state.

Without a doubt, the most desirable method for handling industrial wastes is to recover these wastes for use or reuse. However, in the majority of cases this is not economically feasible. Therefore, the primary requisite in solving a pollution problem or in selecting a method of treatment prior to discharge, is knowledge of the physical state and chemical composition of the waste.

The investigators in this field of waste control employ many techniques and types of analyses in accumulating the data necessary for obtaining adequate solutions to the many problems confronting this organization.

One of the basic tests performed is the determination of dissolved oxygen (DO) concentration in receiving waters. Employing the sodium azide modification of the Winkler Method, the investigator is able to determine whether or not sufficient dissolved oxygen is present in an environment to maintain aquatic fauna.

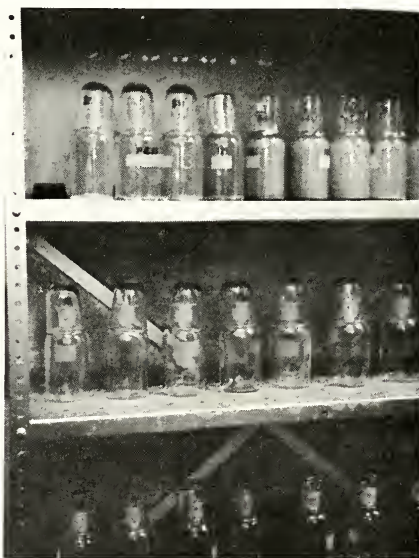
In order to understand the happenings of natural self purification of streams, biological oxidation, it is necessary to keep in mind the fact that the same dissolved oxygen used to maintain fish and other aquatic forms of life also supports the growth of enormous populations of microorganisms (bacteria). These microorganisms utilize this dissolved oxygen in stabilizing (decomposing) the organic wastes mixed with the receiving water.

The most important single determination used for the analysis of decomposable organic matter by means of aerobic biochemical action is referred to as the Biochemical Oxygen Demand (BOD). This BOD analysis furnishes the investigator with a means of determining the amount of oxygen required by microorganisms to decompose a given amount of waste matter. The numerical value of this

test is usually expressed in parts of oxygen per million parts of waste matter.

The data obtained from BOD and DO analyses make it possible to calculate, with a fair degree of accuracy, the ability of a stream to assimilate wastes of different composition. There are, of course, many other factors that must be taken into consideration, such as: (1) thoroughness with which the waste is mixed with the water; (2) changes in the solubility of oxygen in water with changes in temperature, the former increasing as the latter decreases; (3) lowered microbial activity with a decrease in temperature; (4) rate of flow of the receiving stream; (5) changes in the solubility of oxygen in water with an increase of soluble salts; (6) variations in the concentration of waste matter.

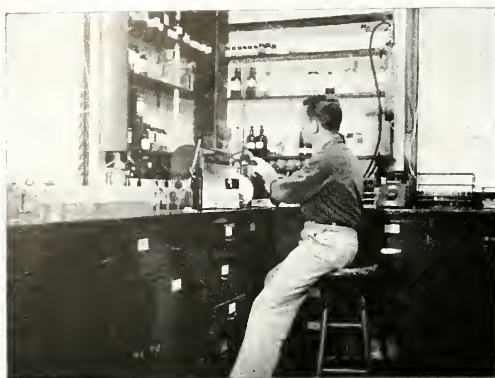
Briefly, the procedure used in carrying out a BOD analysis is as follows: Various quantities of the sample to be tested are prepared in duplicate. These are then mixed with water which has been saturated with oxygen. The dissolved oxygen (DO) is immediately determined on one-half of these samples. The remaining samples are placed in a constant temperature room where they are allowed to incubate for five days at 20°C.



Determination of biochemical oxygen demand requires that one of duplicate samples is stored for five days. Filled sample bottles are shown as they are stored in the constant temperature room.

Following this period of incubation the residual dissolved oxygen is then measured and the BOD values are computed.

It may be worthy to note at this time that the laboratory of the Division is one of the two (2) known laboratories in the state which is capable of and equipped for conducting this type of analysis. The following Table gives an indication of the number of BOD analyses completed during this past biennium.



Chief chemist, Robert Kuss, runs routine analysis of biochemical oxidation demand of bayou water samples.

BOD ANALYSES CONDUCTED DURING 1958-1959

Source of Sample	No. of Samples Analyzed	Percent of Total
Sugar Mills	489	35.0
Municipal Sewage	187	13.0
Food Processing Plants	118	8.0
Mississippi River	128	9.0
Slaughter Houses	134	10.0
Pine Products Plants	8	1.0
Cotton Seed Oil Mills	14	1.0
Paper Mills	153	11.0
Petroleum and Chemical Plants	59	4.0
Miscellaneous Water Bodies	105	8.0
Total	1,395	100.00

Those industries burdened with inorganic waste products have a problem of a somewhat different nature. Normally, inorganic wastes are not subjected to any biological treatment because of their relatively inert nature as a substrate for microbial development. In addition, the discharge of these wastes, because of high alkalinity, acidity or toxicity to microorganisms, may so upset the natural balance of life in waters that natural biological purification cannot progress normally. Therefore, these wastes are usually controlled by physical or chemical separation.

STREAM POLLUTION FROM SUGAR FACTORY DISCHARGES

The 1956-1957 biennial records that the elimination or remarkable abatement of stream pollution arising from the waste discharges of raw sugar factories in the state had become an accomplished fact through the cooperative efforts of the sugar factory managements and the Division of Water Pollution Control.

The 1958 grinding season was carried on during a period of low rainfall and consequently low flow

in the receiving streams. Stream pollution and/or oxygen depletion was a rare occurrence during this season when only one small fish mortality was observed. The season was one of the shortest in terms of number of days duration on record. Weather conditions were ideal for cane harvesting.

The 1959 grinding season was in some respects similar to the 1958 season. Rainfall and stream flow were about equal to that of the 1958 season. At this point however the similarities end. Most factories were late in beginning the grinding season because of low sugar content occasioned by continuous rains in the earlier part of the year. About mid-November or approximately four to five weeks after grinding began, a large part of the cane growing area was subjected to freezing weather followed shortly by periods of warmer weather. These weather conditions caused the souring of unharvested cane. The processing of this soured cane resulted in a deterioration of the quality of waste water (condenser water) being discharged from the factories to the receiving streams. The tabulated biochemical oxygen demand values of condenser water from one of the factories supports the preceding remarks.

BIOCHEMICAL OXYGEN DEMAND ANALYSES FROM SUGAR FACTORY LOCATED AT BREAUX BRIDGE, LOUISIANA

Date (1959)	B.O.D. (ppm)
October 21	53.0
October 27	12.0
November 4	35.0
November 9	28.0*
November 18	32.0
November 23	172.0
December 1	292.0
December 7	197.0

*Date of occurrence of first freeze.

It will be noted that on each sampling of factory effluent discharge after November 9th, the biochemical oxygen demand exhibited a progressive increase. Not all raw sugar factories exhibited the same progressive deterioration of condenser water discharge since the more southerly part of the cane growing area was subjected to less severe weather conditions, hence factories in these areas did not discharge waste of a less desirable quality. The tabulated biochemical oxygen demand values tested below support the above statement.

BIOCHEMICAL OXYGEN DEMAND ANALYSES FROM SUGAR FACTORY LOCATED NEAR THIBODAU, LOUISIANA

Date (1959)	B.O.D. (ppm)
October 19	13.0
October 26	57.0
November 4	14.0
November 9	15.0*
November 16	10.0
November 23	41.0
November 30	25.0
December 7	56.0

*Date of occurrence of first freeze.

Small fish mortalities and oxygen depleted



Impounding basin for the recirculation of cane wash water, Alma Sugar Factory, Lakeland, Louisiana.

streams were reported in Bayou Black near Houma, Louisiana, Bayou Teche between Jeanerette, and Franklin, Louisiana and in small streams in the Lake Boeuf area near Raceland, Louisiana. These minor fish kills caused by waster discharge from sugar factories are in sharp contrast to the widespread stream pollution and wholesale destruction of aquatic life that was recorded a scant five to seven years ago.

In summarizing, it should be noted that in all but one or two instances, methods of waste handling and treatment procedures have progressed as far as knowledge of these procedures will allow. It is the writer's opinion that only an increase in stream flow for dilution purposes can eliminate or abate those stream pollution problems that remain unsolved in the sugar cane grinding area.

OIL EXTRACTIONS

The operation of two important industries, oyster farming and petroleum production, in the same locale has created a serious problem for the members of the Louisiana Wild Life and Fisheries Commission. Briefly, this problem is—can these two industries co-exist?

Many workers have shown that various oil fractions, petroleum production chemicals and products do not have detrimental effects upon oysters. On-the-other-hand, it also has been found that these same products do impart an oily, undesirable taste to the oysters making them unfit for human consumption.

To date, it has been reasonably established that the undesirable oily taste of some oysters is more frequently than not caused by the contamination of oyster growing areas with crude oil. In many cases this contamination has been found to be caused by the discharge of drilling muds or the constituents used therein, namely, diesel fuel and kerosene. Some drilling operations, at depths of around 10,000 feet, add as much as 14 percent by volume of oil to their drilling muds.

It has been well established by analyses that crude oils, regardless of the geographic area from which they have been secured, are composed of 83 to 87 percent carbon and 11 to 14 percent hydrogen, or in effect 98 to 99 percent hydrocarbons.

Various studies by members of this Division and the Division of Oysters, Water Bottoms and Com-

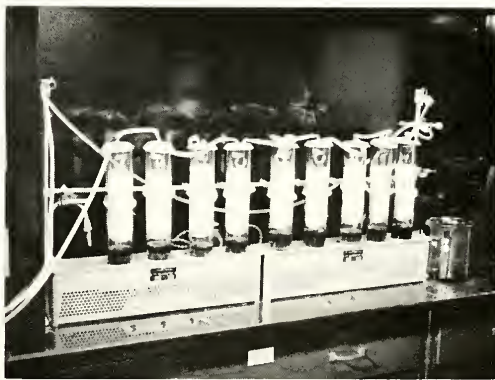
mmercial Seafoods revealed that these oil fractions were being absorbed by well cuttings and suspended particles in the water. Therefore, the best logical approach to this problem from a chemical standpoint was to:

- (a) Find a method for recovering these oil fractions from both bottom muds and overlying waters.
- (b) Prove that the recovered oil was actually a petroleum product in origin.
- (c) Demonstrate that these same hydrocarbons could not be recovered from non-contaminated oyster growing areas.
- (d) Show that these hydrocarbons could be found in contaminated oysters but not in non-contaminated ones.

As a result of close cooperation and liaison between this Division, Coastal Waste Inspectors of the Division of Oysters, Water Bottoms and Commercial Seafoods, and several Marine Biologists, the former Chief Chemist of this Division, Charles D. Vernon, developed a method for the extraction of oils from mud. This work is to be published in the near future by the American Chemical Society. Briefly, the steps of this process are outlined below:

1. Drying of mud samples at temperatures ranging from 30 to 103° C depending on the water content of the sample when received.

2. Extraction of the dried sample with a non-polar, selective solvent for varied time intervals depending on the concentration of oil in the sample.



Several cylindrical extractors with porous thimbles containing oil impregnated mud samples are shown during an extraction process.

3. Sulfur removal with freshly prepared powdered copper.

4. Reduction of intermediate organic decomposition products of the extract mixture.

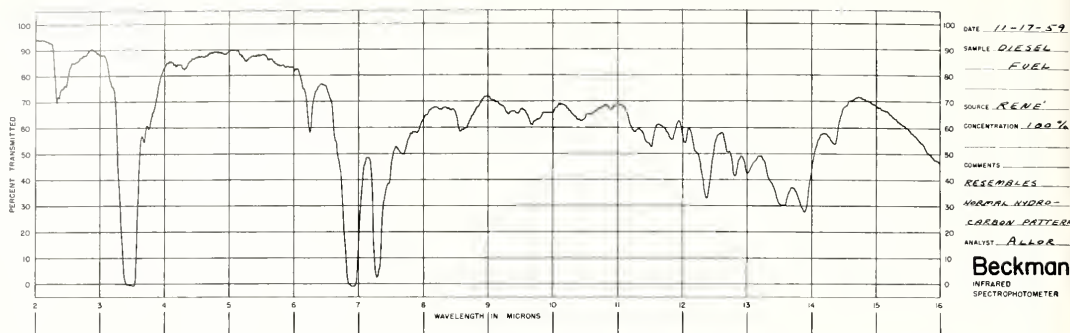
5. Chromatographic absorption for the further removal of interferences.

6. Solvent removal in two stages.

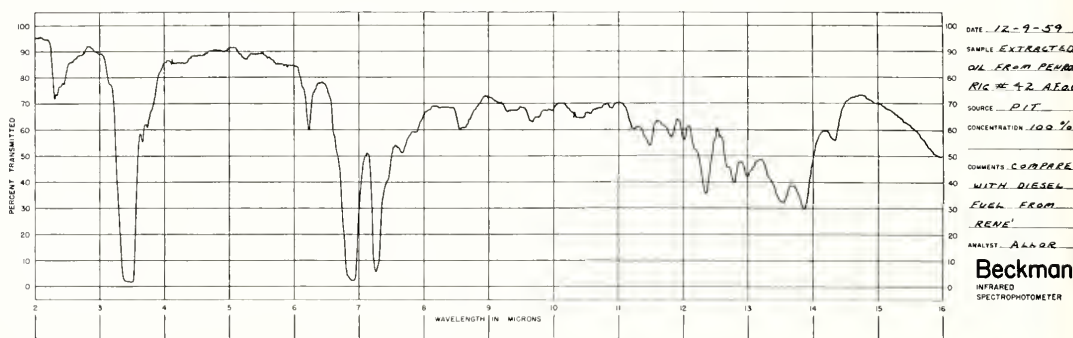
7. Determine the weight of the extracted hydrocarbons using the analytical balance.

8. Confirmation of analytical results by infrared spectroscopy.

Samples received in this laboratory as oil emulsions or as two separate layers of oil and water but which have very little solid material in them



Similar infrared spectra of diesel fuel and extracted oil sample illustrate how unknown oil samples can be more positively identified. These results indicate that the oil in the water extracted was from the neighboring rig which used diesel fuel in its drilling operation.

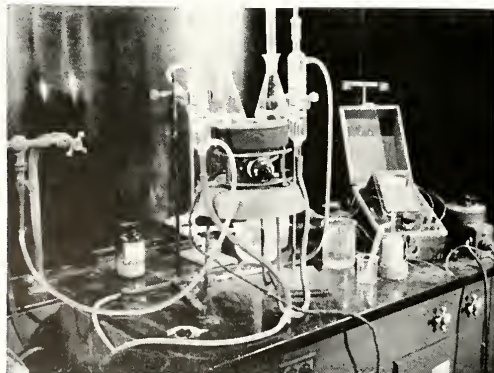


are extracted with a liquid-liquid continuous flow extractor.

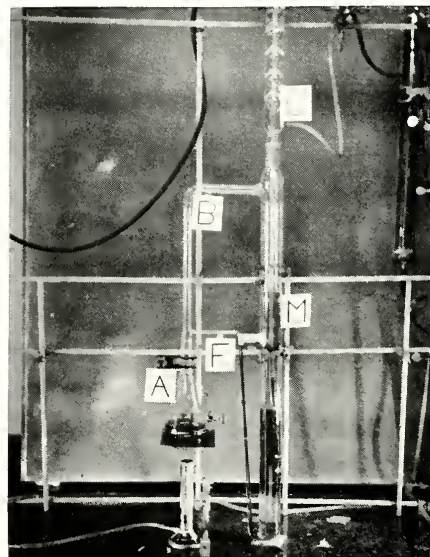
The bottom of the extraction cylinder (M) is filled to a two inch depth with Raschig rings or loose chips of glass. Above these rings is packed a column of glass wool about three inches high.

A piece of $\frac{1}{4}$ inch glass tubing extends through the condenser (C) into the cylinder, ending at a point about one inch above the glass wool packing. The end of this tubing is fitted with a small glass

In order to perform an extraction, a flask (A) is attached to the end of the $\frac{3}{4}$ inch side tube (B)



Once oil is extracted from mud, the solvent used is reduced in volume by evaporation. The illustrated glass stills are used for this process. Complete removal of the solvent is effected with the semi-micro still seen in the background.



Extraction of oil from water is effected with a continuous flow, liquid-liquid extractor. The all glass apparatus consists of a boiling flask, (A); vapor transfer tube, (B); condenser, (C); extraction cylinder, (M); and solvent return tube, (F). An air bubbler extends through the condenser and into the extraction cylinder.

bulb which is perforated with hundreds of minute pores. Air is forced through this tube and provides bubbling through its porous tip when emersed in a liquid.

and is filled to approximately one-fourth its volume with carbon tetrachloride which will serve as a solvent.

Carbon tetrachloride is also added to the extraction cylinder until it appears to be approximately one-third full.

The water to be extracted is acidified and added to the cylinder. Water does not mix with carbon tetrachloride and is lighter, so the water sample will rest as a layer above the carbon tetrachloride.

Bubbling is initiated by applying a constant stream of air through the top end of the $\frac{1}{4}$ inch glass tubing described earlier and heat is applied to the flask.

As the solvent boils, vapors rise through the $\frac{3}{4}$ inch side tube and are conveyed to the top of the cylinder where they are converted to a liquid by the condenser. The liquid solvent then drops through the water layer with which it is thoroughly mixed because of the stream of air bubbles rising to the top of the liquid. The solvent finally drops completely through the water layer and joins the solvent layer in the lower part of the cylinder.

As the lower layer of solvent increases in volume, it is allowed to overflow through a $\frac{3}{8}$ inch glass tube (F) back into the flask where it can be boiled and recycled.

Thus, a continuous flow of fresh solvent is constantly being passed through the water sample. Since the oils are more soluble in the carbon tetrachloride solvent, they are dissolved in it and are eventually transferred to the flask where they accumulate.

Following the extraction, the solvent is treated just as it was in the procedure for the extraction of coastal drilling muds, that is, evaporation of the solvent, weighing and confirmation of the results.

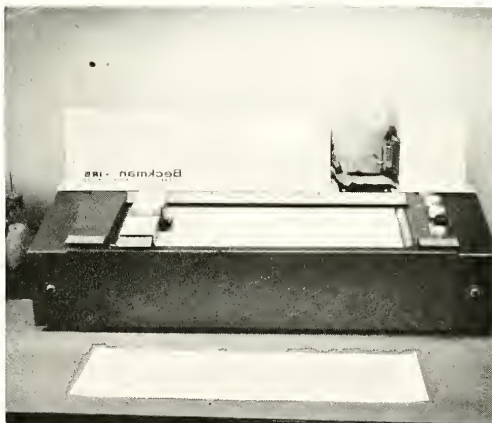
It might be worthy of mention at this time that the recent purchase of the IR-5 Spectrophotometer has greatly facilitated the analysis of many organic substances, particularly so with oils and grease. In an attempt to compile a library of spectra it is now a matter of policy that all organics extracted in this laboratory be analyzed for their infrared absorbing qualities.

Various types of compounds have characteristic infrared absorption patterns which are automatically recorded on a graph. This enables the analyst to determine, with a high degree of certainty, the structural characteristics of an unknown sample and perhaps its identity.

This method is best applied when it is complemented with specific chemical tests and spectra of known organic compounds, all of which enable the analyst to more conclusively identify the compound.

WATER QUALITY PROGRAM

The Water Quality Program of the Division of Water Pollution Control was begun in June, 1958 as a complement to those surface water quality studies being made by the Louisiana Geological Sur-



The Beckman infrared spectrophotometer scans infrared wavelengths from two to sixteen microns and automatically records, on a graph, absorption by a sample at all wavelengths within its range.

vey and the U. S. Geological Survey. Much attention has been given to the quantity of our water resources. Even more attention is being given to the chemical quality of our waters inasmuch as it is of equal importance. The streams are being constantly scrutinized so that their multiple uses—recreational, municipal, industrial, and agricultural—may be conserved in the tradition of a progressive state.

This program is a chemical assay of the state surface waters. The specific objectives of this basic data collection survey are:

1. To investigate the effect of domestic and industrial wastes on the receiving waters.
2. To examine the progress of self purification and recovery of the streams.
3. To determine the effectiveness of sewage and industrial waste treatment.
4. To advance the study of fish and other aquatic life, chemical and physical data must be known. When this data is added to biological, bacteriological, and hydrological facts, a more complete picture is formed as to those interpretations which may lead to improved sport and commercial fishing.

To execute the water quality program, samples are taken at strategic points so that a representative portion of the water is taken for analysis. These sampling stations are not located near small channels, springs or other atypical environments which would only reflect the quality of that water in a minute, relatively unimportant local situation.

In this program thirty-eight stations, located on some thirty streams through the state, were selected to project the true quality of our surface waters. From June 1958 to May 1959 samples were taken bi-weekly. For the remainder of 1959 the samples were taken monthly. Waste disposal inspectors in assigned geographic areas collected the samples and immediately made certain chemical and physical tests in the field. The inspectors then shipped the water samples to the Water Pollution Control Laboratory at Baton Rouge where the quantitative chemical analyses were made plus the physical tests such as color, specific con-



James Mathis, chemist, instructs Warden Dixon, a waste disposal inspector, in laboratory techniques.

ductance and turbidity.

The chemical and physical analyses were performed by individuals formally trained in the field of chemistry and physics and experienced in water analysis. The methods employed in conducting these analyses are in accordance with those prescribed in *"Standard Methods for the Examination of Water, Sewage, and Industrial Wastes,"* Tenth Edition, 1955.

Some of the methods of analysis along with their significance and the instruments and other apparatus employed are discussed below:

pH

pH is defined as the negative logarithm of the hydrogen ion concentration or, more precisely, the hydrogen ion activity. pH, a measure of the free or dissociated hydrogen ion, is measured electrometrically in the laboratory using a Beckman pH meter. In the field this is accomplished by using either a portable colorimetric kit or a portable battery operated pH meter. pH enters into the calculation of carbonate (CO_3^{--}), carbon dioxide (CO_2), and corrosion or stability index. In addition, pH is important in the control of water treatment and chemical reactions such as those occurring in quantitative chemical analysis. The pH scale ranges from 14, very alkaline, to 1, very acid, with 7 being the neutral value.

DISSOLVED OXYGEN (DO)

Knowledge of the concentration of oxygen dissolved in water is essential in biological, chemical and sanitary investigations. Oxygen depletion or DO values of less than 2.0 parts per million must be examined closely. The cause must be determined and corrections made because dissolved oxygen concentrations at or below this value will not adequately support aquatic fauna and may result in decreased production or an actual mortality.

In the laboratory and field, DO concentrations are determined by the modified Winkler method. In all cases, the dissolved oxygen is best determined in the field, thereby preventing any alteration of the sample due to changes in temperature or microbial respiration. The La Motte DO kit has been found to be most suitable for this purpose.

PER CENT SATURATION

At each temperature, there is a maximum DO value expressed in milligrams of oxygen per liter of water. The per cent saturation is calculated from the measured DO value and temperature and the handbook saturation values for the concentration of DO in water at a given temperature.

TURBIDITY

Turbidity is caused by the presence of suspended matter such as clay, silt, finely divided organic matter, plankton and other microscopic organisms. It is the optical property of a sample which causes light rays to be scattered and absorbed rather than transmitted in a straight line through the water. Turbidity depends on the optical properties of particles such as size, shape and refractive index.

The Jackson Candle Method is used in the laboratory to measure turbidity. In it a constant and reproducible light source and path are provided. Light from a standard beeswax and spermaceti candle which burns 114 to 126 grains per hour passes through the sample contained in a calibrated cylinder with a flat polished optical glass bottom. The operator looking down through the sample adds freshly shaken increments of turbid sample until the image of the candle flame disappears. Turbidity values are reported in whole numbers based on the Jackson Candle system which is the primary standard for expressing the degree of turbidity.

COLOR

Color in water is caused by plankton and other aquatic organisms and also by the natural occurrences of minerals and chemicals. Sometimes color is produced in water by industrial effluents, such as paper mills, refineries, etc., or the formation of products from chemical and bacteriological reactions among different wastes. True color is due to dissolved substances; apparent color to suspended matter.

In the water quality program, true color is measured with a Hellige Colorimeter with specially calibrated glass color discs. Light transmission characteristics such as dominant wave length (hue), saturation (purity), luminance (degree of brightness), are important considerations. Values for color are expressed in whole numbers. The color unit is based on a mg. of platinum in a liter of water.

SPECIFIC CONDUCTANCE

Specific conductance is an electro-chemical measurement. Pure water having infinite resistance will not conduct an electric current. However, if minerals or other chemicals are dissolved in this same liquid and dissociate into positive and negative ions (charged particles), conductance is increased and conversely, electrical resistance is decreased. Therefore, conductance actually indicates the quantity of ionized constituents present in a sample. The conductivity is closely related to the sum of either the positively charged ions (cations) or the negatively charged ions (anion). This measurement is valuable to the analyst as it is easily correlated with the



Routine titrimetry and other determinations are carried out at a central work area in the chemistry section of the laboratory.

total dissolved solids and enables him to better estimate the size of aliquots for chemical determinations.

In the Baton Rouge laboratory of the Division of Water Pollution Control, specific conductance is measured with a Fisher Titrimeter arranged to form a Weststone Bridge circuit. A conductivity cell is attached to this instrument so that, when the cell is immersed into the sample, the resistance is measured directly in ohms. The temperature of this sample is also measured and recorded. In like manner, the temperature and resistance of a 0.01N KCl solution is measured and recorded. From these two experimentally determined values and the conductance value for standard KCl at 25° C, obtained from the literature, the specific conductance is readily calculated in micromhos per centimeter.

TEMPERATURE

Temperature, although easily determined, is none-the-less important. It effects the rate of chemical reactions, dissolved oxygen concentrations, rate of physiological processes, physical states of matter, viscosity, odor, taste, and development of aquatic organisms including fish. In the water quality program it is measured with various types of thermometers but is always reported in degree Centigrade (°C).

ALKALINITY

Alkalinity in water is essentially caused by the presence of bicarbonate, carbonate and hydroxide ions. It is the reserve buffering capacity of a water. Receiving waters having a relatively high alkalinity (not pH) are better able to maintain a constant pH when acid or alkaline materials are introduced into them.

In the lab, total alkalinity is determined by titration with standard acid to an equivalence point of 4.5 which is measured with a standardized Beckman pH meter. The accuracy of the instrument is checked several times during each series of measurements using a commercial buffer. Alkalinity values are reported in ppm.

HARDNESS

Soap consumption and scaling in pipes are the result of hardness in water. Calcium and magnesium are the principle hardness producing elements, however, all of the metallic cations present in a sample, except the alkali metals such as sodium and potassium, contribute to the total hardness.

The compleximetric or ethylenediaminetetraacetic (EDTA) titration method is used in determining hardness. Ammonium hydroxide is added to the sample to be tested in order to overcome any natural buffering capacity existing in this solution; sodium sulfide is added to inhibit the precipitation of calcium carbonate. Standard EDTA is added until the end point is detected visually. An indicator, Chrome Black T complexes with the slight excess of titrant to indicate a color change at the equivalence point. Hardness is reported in ppm as the equivalent CaCO₃ concentration.

CHLORIDE

The characterizing constituent of brines and sea water is sodium chloride, which is found in the pure form as table salt. In water analysis, determinations are done for the total chloride ion present, although this ion may be found in many forms other than in conjunction with sodium. The U. S. Public Health Service Drinking Water Standards of 1946 established the upper limit at 250 mg/liter of Cl⁻ in acceptable water supplies.

A volumetric quantitative analysis is performed in the laboratory using mercuric nitrate as a titrant with a mixed indicator at a controlled pH. The mercuric nitrate is added to the prepared sample until there is a slight excess of mercuric ions that form a violet color when combined with the diphenolocarbozone indicator. The chloride ion concentration is calculated and reported as mg/l Cl⁻.

SODIUM

Sodium occurs in most natural waters and is found in certain industrial effluents. In a water softening process, sodium is the ion exchanged for the hardness producing ions of calcium and magnesium. A high sodium concentration is detrimental to certain plants. Therefore, the concentration of sodium in water is important in agriculture.

POTASSIUM

Another of the alkali metals is potassium. It is much less abundant than sodium in natural waters, however, what it lacks in quantity it makes up in quality for it is a major source of natural (background) radioactivity due to the naturally occurring isotope K⁴⁰.

Flame photometry is the method used in determining both sodium and potassium. The sample is pulled into the oxy-acetylene flame where the atoms of these elements are easily energized and emit a characteristic spectrum. This excitation is carried out under carefully controlled, reproducible conditions. A device is used to isolate the desired monochromatic spectral line. A phototube potentiometer circuit measures the intensity of light transmitted

TABLE I. WATER QUALITY ANALYSES OF OUACHITA RIVER
(at Sterlington off Bridge) (1958)

Date Collected	Temperature °C	Dissolved Oxygen	% Saturation	pH (field)	pH (lab)	Turbidity	Total Alkalinity as CaCO ₃ (TDA)	Total Hardness	Color	Sodium	Potassium	Specific Conductance (micromhos at 25°C)	Iron	Chloride
<i>JUNE</i>														
A ¹	23.5	1.0	11.8	6.5	....	30*	18	18	50	6.5	.....	77.3	0.2	6.2
B	25.5	0.2	2.4	6.6	....	32*	26.0	25.6	50	16	2	155.7	.66	29.37
<i>JULY</i>														
A	26.5	0.2	2.5	6.7	....	30*	28.0	33.2	35	**	**	194.8	.029	41.25
B	28	0.6	7.6	7.0	....	30	34.0	47.0	20	34	2.5	357.2	.036	7.18
<i>AUG.</i>														
A	30.5	2.5	36	6.5	6.9	32	26.0	70.2	25	49	3	714.4	0.0704	162.5
B	30	5.0	75	6.7	7.0	30*	31.0	92.4	25	**	**	918.6	.....	241.5
<i>SEPT.</i>														
A	28.5	5.8	74.4	6.6	6.4	40*	16	104	35	67	4.7	**	0.069	164
B	25	5.4	.....	6.6	6.7	36	16	48	30	38	4.2	**	0.129	59.9
<i>OCT.</i>														
A	22	3.6	40.9	6.2	6.5	30*	12	31.6	45	28	3.5	**	0.024	32.9
B	22	6.2	70.5	6.7	6.5	33	26	55	35	47	6	**	0.010	67.4
<i>NOV.</i>														
A	17	8.1	82.7	6.8	6.8	30*	22	67.2	10	58	10	804	0.045	97.7
B	21	8.5	94.4	7.1	6.5	30*	26	132.4	20	68	6	1837	0.072	314
<i>DEC.</i>														
A	13	9.3	87.7	7.1	6.7	30*	22	67.2	30	66	5	643	0.066	120
B	7	12.2	174.2	7.1	6.7	30*	21	67.8	20	83	7.6	714	0.120	115
(1959)														
<i>JAN.</i>														
A	3	11.5	85	6.8	6.8	30*	17	99.2	20	108	5.5	1286	.....	220
B	9	12.2	105	6.8	6.6	30*	20	75.2	20	93	7.5	919	.....	156
<i>FEB.</i>														
A	7	10.9	89.5	6.8	6.6	32*	20	67.2	25	110	8	857	.....	133
B	12	8.0	73.8	6.5	6.6	40	12	48.8	50	108	8	612	.....	10.7
<i>MAR.</i>														
A	12	7.8	72.0	6.5	6.2	30	12	26	50	60.5	6	207	.....	31
B	14	7.1	68.5	6.4	6.8	30*	14	36	40	65	8.5	330	.....	159
<i>APR.</i>														
A	20	5.8	63.3	6.2	6.5	30*	14	48.8	40	74.5	8.3	428	.....	68.1
B	18	6.4	67.2	6.6	6.6	30*	20	54	30	84	10	585	.....	90.4
<i>MAY</i>														
	25	4.2	50.2	6.5	7.1	30*	18.2	43.6	40	73	7.0	380	.....	65
<i>JUNE</i>														
	27	6.4	79.7	6.9	6.7	30*	28	186	30	171	13.2	1786	.....	478
<i>JULY</i>														
	29	5.0	64.3	6.6	7.0	35*	28.4	58.8	65	73	7.5	441	.....	89.3
<i>AUG.</i>														
	31	5.8	77.6	6.7	6.8	30*	24.6	94.8	30	121	4	791	.....	199.1
<i>SEPT.</i>														
	30	6.6	86.6	6.9	6.9	32*	28	99.6	18	144	4.1	543	.....	211.5
<i>OCT.</i>														
	27.0	7.3	91.0	7.1	7.5	30*	27.0	108.4	20	186.0	6.0	659.0	.....	239.0
<i>NOV.</i>														
	20.0	8.0	87.1	7.1	7.3	30*	40.0	92.0	20	114.0	6.5	635.0	.....	161.3
<i>DEC.</i>														
	11.0	10.3	93.2	6.8	7.3	30*	37.0	102.0	20	135.0	7.0	736.0	.....	188.5

¹A—Sample collected between 1st and 15th of month.

B—Sample collected between 16th and 31st of month

**Instrument inoperative

*Less than

TABLE II. WATER QUALITY ANALYSES OF OUACHITA RIVER
at Monroe, La., 300 yards above Lock and Dam No. 4
June, 1958 - December, 1959

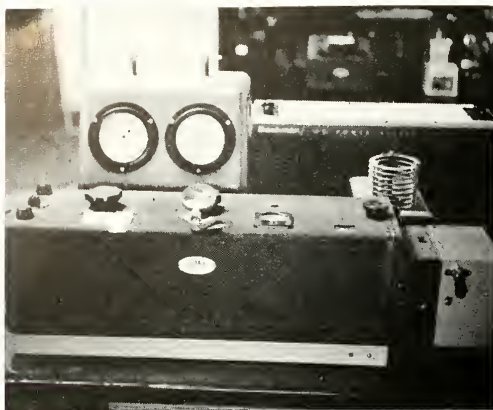
Date Collected	Temperature °C	Dissolved Oxygen	% Saturation	pH (field)	pH (lab)	Turbidity	Total Alkalinity	Total Hardness as CaCo ₃ (EDTA)	Color	Sodium	Potassium	Specific Conductance (micromohs at 25°C)	Iron	Chloride
JUNE														
A†	.....	1.2	.....	6.7	.....	30*	20	16	50	8.0	.....	87.7	0.2	7.0
B	25	0.6	7.1	6.4	.....	30*	21.0	23.6	40	10	4	99.5	.13	18.75
JULY														
A	25	0.6	7.1	7.1	.....	30	38.2	39.2	20	**	**	189.1	.08	33.74
B	27.5	1.0	12.7	7.2	.....	30	26.4	43.2	40	37	2.0	338.4	.228	96.0
AUG.														
A	30.5	1.8	13	6.2	6.1	32*	21.8	72.0	30	46	4	535.8	0.2134	130
B	19.5	4.0	43.5	6.9	6.8	30*	34.2	90.4	20	**	**	803.8	.....	227
SEPT.														
A	28	4.6	58.2	6.6	6.2	40	24.0	82.0	25	70	6.7	**	0.159	131
B	25	4.3	51.2	6.7	6.3	29	14.0	55.0	30	43	4.2	**	0.071	71.8
OCT.														
A	22	3.8	41.2	6.5	6.8	30*	18.0	30.0	50	31	4.8	**	0.042	32.9
B	22	4.5	51.1	6.6	6.5	30*	24.0	50.0	30	41	5	**	0.027	63
NOV.														
A	17	7.2	73.5	7.0	6.8	30*	22.0	72	30	57	8	830	0.075	97.7
B	22	7.4	84.1	7.0	6.6	30*	24.0	94.0	30	67	4	128.6	0.350	205
DEC.														
A	13	9.6	90.6	7.2	6.6	30*	6.0	84.0	30	75	15	824	0.081	144
B	8	11.8	99.2	7.1	6.3	30*	20.0	61.0	20	83	8	714	0.015	108
(1959)														
JAN.														
A	9.0	11.1	95.7	6.8	6.7	30*	20.0	102.8	20	106.0	5.0	1,169	.....	200.0
B	9.0	11.2	96.5	6.9	6.5	40	20.0	92.0	25	111.0	8.5	1,169	.....	218.0
FEB.														
A	7.0	11.6	95.2	6.8	6.9	30*	20.0	64.0	30	115.0	9.5	585.0	.....	120.0
B	14.0	7.9	76.0	6.5	6.7	40	14.0	44.0	40	101.0	7.0	536.0	.....	82.4
MAR.														
A	13.0	7.4	69.7	6.6	6.8	40	14.0	48.0	40	44.0	6.0	195.0	.....	30.0
B	15.0	7.0	69.0	6.5	6.4	30*	12.0	33.6	50	67.0	9.0	322.0	.....	69.0
APR.														
A	19.0	6.4	68.5	6.2	6.5	30*	10	45.6	30	74	10	459	.....	65.2
B	18.0	6.4	67.2	6.6	6.6	30*	20	52	30	93	8.3	495	.....	84.3
MAY	25	4.2	52	6.6	7.3	30*	17.8	40.8	30	68	7.1	299	.....	65
JUNE	27	5.4	67.5	6.7	7.5	45*	24	132	20	162	14	1,260	.....	210.7
JULY	29	3.4	43.8	6.6	6.8	30*	31	54	45	67	7.5	412	.....	86.7
AUG.	31	5.2	79.6	6.7	6.4	30*	14	76	25	93	3.6	659	.....	156.3
SEPT.	31	5.4	72.2	7.0	7.5	33	29	85.2	22	120	3.8	487	.....	170.7
OCT.	28	5.2	65.6	6.9	7.6	30*	46	154.8	20	238	7.0	887	.....	324.5
NOV.	20	5.6	61.2	7.0	7.4	30*	35	108	25	148	8.0	813	.....	219.3
DEC.	12	8.6	79.3	7.2	6.7	30*	33	112	20	132	5.5	793	.....	197.9

†A—Sample collected between 1st and 15th of month

B—Sample collected between 16th and 31st of month

*Instrument inoperative

*Less than



The Beckman DU spectrophotometer is used principally to analyze for sodium and potassium by measuring the intensity of a characteristic frequency of light that the sample imparts to an oxygen-acetylene flame.

when the sample is vaporized. A Beckman Model DU Quartz Spectrophotometer with flame attachment, power supply and photomultiplier assembly is the instrument employed in these analyses (see picture). Sodium and potassium are reported in the data table as ppm.

To depict the manner in which this data is compiled the following Tables I and II are presented. Table I shows analyses from the Ouachita River at Sterlington, La. from June, 1958 through December, 1959. Table II shows analyses from the Ouachita River at Monroe, La., 300 yards above Lock and Dam No. 4, from June, 1958 through December, 1959.

TECHNICAL PAPERS AND ACTIVITIES BY THE DIVISION

The following technical papers were authored by Division personnel during the biennium.

1. "Some Current Waste Treatment Practices in Louisiana Industry," Biglane, K. E., Engineering Bulletin, Proceedings of the 13th Industrial Waste Conference, Purdue University, Lafayette, Indiana, May, 1958.
2. "Application of Biological Findings to Water Pollution Problems in Louisiana." Biglane, K. E. To be published in the Second Seminar on Biological Problems in Water Pollution by the Robert A. Taft Engineering Center, Cincinnati, Ohio, April 23, 1959.
3. "Protection of Water Resources for Multipurpose Utilization," Biglane, K. E., presented to the Senate Select Committee on National Water Resources in Alexandria, Louisiana, on December 1, 1959.
4. "Determination of Hydrocarbons in Oyster Beds Polluted by Petroleum Operations," Vernon, Charles D., submitted to American Chemical Society for publication, December, 1959.
5. "Report on Stream Pollution and All Sugar Factories in Louisiana", Lafleur, R. A., prepared for general distribution, February, 1958.
6. "Investigations in the Norco-Destrehan Area

Drainage System", Gregg, Dr. R. T., prepared for general distribution, June, 1958.

7. "Report on Survey of Bayou Bonfua, St. Tammany Parish, Louisiana", Gregg, Dr. R. T., July, 1958.
8. "Report on Bioassay of Heptachlor and Endrin," Gregg, Dr. R. T., prepared for general distribution, June, 1959.
9. "Report on Bioassay of Bit-Lube", Gregg, Dr. R. T., prepared for general distribution, December, 1959.
10. "Report on Bayou Boeuf Stream Pollution and Operations of Hi-Pro Fish Products, Inc., Amelia, Louisiana", Gregg, Dr. R. T., and staff, July, 1959.

In addition to the above, speeches were prepared and given to the National Meeting of the Federation of Sewage and Industrial Wastes Association in Dallas, Texas in October, 1959, and to the American Water Works Association in New Orleans in October, 1959.

In 1958, the Stream Control Commission was delegated to a five member Interim Committee of the State and Interstate Water Pollution Control Administrators. This Committee works in close cooperation with the U. S. Surgeon General and is constantly in touch with the other 45 states regarding national attitudes and policies on water pollution problems.

COTTON VALLEY OPERATORS COMMITTEE PROCESS AND COOLING WATER DISPOSAL DECEMBER 8, 1959

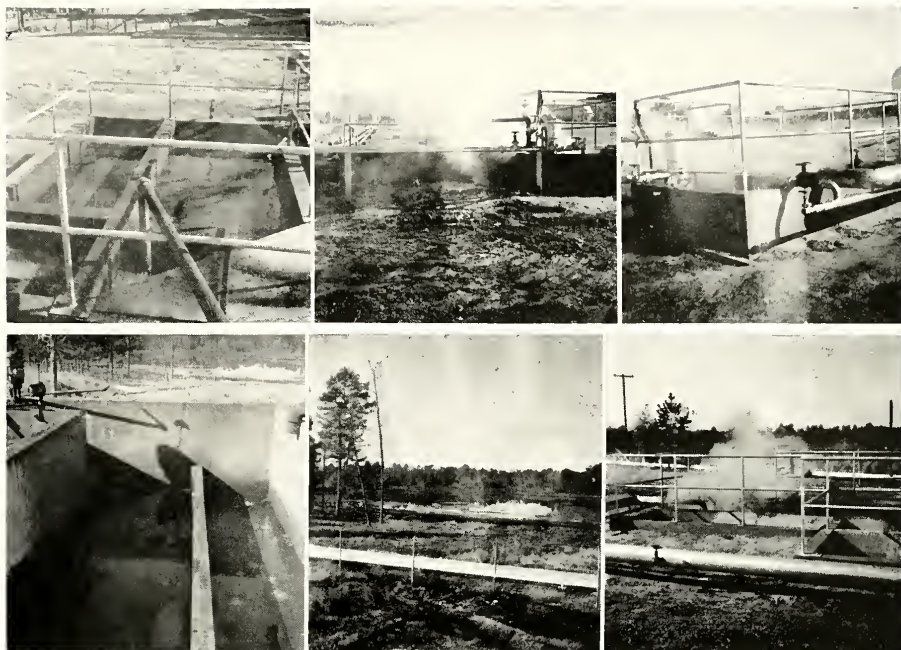
Following is a brief summary of the additions to the process and cooling water disposal system at Cotton Valley Operators Committee in the last fifteen months.

The oil and water separator on the east side of the plant was rebuilt during the latter part of 1958 in order to increase capacity to the oil water separation. This basin was constructed at a cost of approximately \$2,800.

In the summer of 1959, a new basin was constructed on the west side of the plant and at an elevation to allow all process water that might be contaminated with oil to flow through. This basin was increased in size to give more efficient operation.

Up to this time, the tank drainage from the tank farm was separated in an earthen pit on the northwest side of the plant. A new separator basin was constructed to take this water and eliminate the pit. In addition, provisions were made for the west plant basin to drain to this pit. A water pump is being installed in this basin to send all water to the east side of the plant and eliminate all process and cooling water to the lake on the west side of the plant. This work was accomplished at a cost of approximately \$15,500.

As a safety measure, all the water discharged will go through an earthen sump on the east side of the plant before discharge into the drain from the plant.



The oil and water separator installed by the Cotton Valley Operators Committee. The new separator basin eliminates an earthen pit on the northwest side of the plant.

MISSISSIPPI RIVER SURVEY

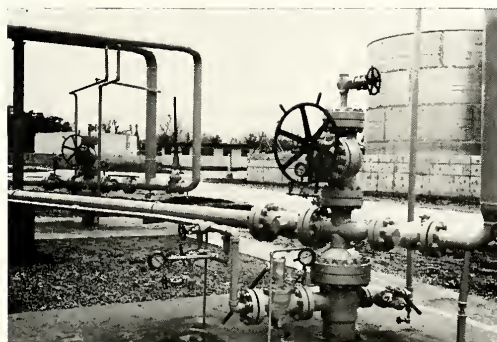
An intensive survey of the Mississippi River was begun in late December, 1957, when the Division received a thirty foot steel research craft to be used primarily in this work. This program has been continued throughout the biennium and will be continued for an extended and indefinite period into the future.

It is felt by the Division personnel that a basic knowledge of the complexities of the Mississippi River is extremely necessary for continued efficient operation as an advisory group to the Stream Control Commission. This knowledge must include the normal variations of natural conditions of the river in addition to the affects of wastes from existing

and future industries and municipalities.

In importance as a source of water for municipal use in Louisiana, the Mississippi River is second to no other, including the entire ground waters of the state. In the area downstream from Baton Rouge the river is the source of municipal water for the entirety or portions of eleven parishes and a population of over 1,000,000. It is anticipated that municipal use of river water will greatly increase in the future as more and more new industries lead to ever increasing concentrations of population on the lower Mississippi River.

It is in conjunction with municipal use that the major pollution problems occur at present and this is even more likely to be the case in the future. The principal complaint is one of taste and odor in



This disposal well installation helps to dispose of waste streams at the Shell Chemical Company, Norco, Louisiana Plant. Initial disposal well operation was started at this plant in 1956.



Waste disposal inspector Warden Dixon is shown on the Blue Gill II taking a sample of Mississippi River water at the Esso outfall.

water used for human consumption. Some of the complaints of taste and odor are attributable to natural causes such as a musty taste caused by products released by algal blooms during periods of low flow and warm weather. However, most of the complaints are attributable to wastes discharged by industries, particularly wastes of an organic nature such as those of petroleum refineries and plants producing organic chemicals. These wastes themselves may be objectionable due to their chemical nature, or may become objectionable only when combined with substances already present in the river or when subjected to water treatment practices such as chlorination. In addition, a guard must be maintained against wastes which may be toxic, increase corrosion, or have other undesirable affects.

The quality requirements of water for industrial use, with the possible exception of food processing industries, are not as critical as those for municipal use. However, addition to the river of wastes substances which increase corrosion, scaling, and sedimentation in cooling systems or which lower heat exchange capacity should be held to the practical minimum. In fact, adequate water quality must be maintained if the lower Mississippi River with its vast supply of water, nearly raw materials, and fine facilities for water transportation is to remain the great attraction for new industry that it is at present. Industries along the river are now using over 2,000,000,000 gallons of water per day and it seems reasonable to assume that within the next generation this use may increase severalfold. Most of this water is used on a once through basis and returned to the river with changes ranging from no more than a slight rise in temperature to a heavy charging with varied wastes.

For the purpose of obtaining the chemical data and some of the biological data, samples have been collected at approximately weekly intervals along a 47 mile stretch of the river. Within this section eight sampling stations were selected in such a manner as to obtain base line data for water quality of the river and to determine the affects of the Baton Rouge complex on the water quality. These stations are as follows:

Station 1. Mile 237 AHP. This station is used for base line data and is located well upstream from any of the industrial outfalls.

Station 2. Mile 229.5 AHP. This station is located approximately $\frac{3}{4}$ of a mile downstream from the last industrial outfall.

Station 3. Mile 225 AHP. This is about 1 mile downstream from the last (University) sewage outfall and just above the first bend in the river downstream from the Baton Rouge complex.

Station 4. Mile 221.5 AHP. This station is in the middle of the first bend.

Station 5. Mile 219 AHP. This location is just below the first bend.

Station 6. Mile 206.5 AHP. This is just downstream from the town of Plaquemine and the Dow Chemical Company.

Station 7. Mile 191 AHP. This station is at the U. S. Public Health Service Hospital at Carville. This is the first waterworks below Baton Rouge,

Louisiana.

Station 8. Mile 190 AHP. This is below the Carville sewage outfall.

At each station samples are taken at the left bank, middle of the river, and right bank, (designation facing downstream). Initially samples were also taken at the bottom, middle depth (when depth of water justified), and surface, resulting in nine samples per station in many cases. However, vertical uniformity of the waters indicated that the added analytical load was not justified and the samples were reduced to only surface samples. For the same reason Stations 7 and 8 were dropped during late 1959 as the results obtained for these stations did not differ significantly from those for station 6.

For all practical purposes, the vast majority of routine tests conducted on Mississippi River water are the same as those employed in the afore mentioned Water Quality Program, with several additions. The most important of these additional tests are the Biochemical Oxygen Demand (BOD) and an estimation of the density of organisms of the coliform group by means of the Most Probable Number (MPN). The MPN test is generally used as an indicator of the potability of a water supply, or indirectly as a measuring device for determining the degree of contamination by domestic sewage.

This test is carried out by inoculating a series of five sterile lactose broth fermentation tubes for each dilution of the sample used (the number of dilutions used are dependent upon the experience of the analyst and the past history of the water). These tubes are then incubated for 24 hours at 35° to 37°C and are then inspected for the formation of gas. The ability of an organism to produce gas, fermentation of lactose, is a predominate characteristic of organisms of the coliform group. The total number of fermentation tubes showing the production of gas are evaluated and interpreted according to tables of probability, from which is obtained an estimation of the number of coliform organisms present. This value of the MPN is normally recorded as MPN per 100 milliliter of sample.



The Thelco oven is used to incubate inoculated tubes of standard lactose broth in obtaining an estimation of the most probable number of coliforms in Mississippi River water. Russell Allor, chemist, inspects inoculated culture tubes for gas production.

RANGES FOUND IN SELECTED ANALYSES OF THE MISSISSIPPI RIVER

	Conductivity (Mhos/cm)	Coliforms (MPN/100 ml)	Cl ⁻ ppm	Turbidity (Scale Units)	Total Alkalinity (as CaCO ₃ ppm)	Hardness
Station 1						
Left	255-448	470- 4,900	12.2- 42.4	125- 690	70-134	102-170
Center	255-458	490- 2,400	12.0- 42.4	105- 700	80-134	102-170
Right	255-458	870- 2,400	12.2- 42.4	95- 720	85-138	102-170
Station 2						
Left	298-528	230- 3,500	23.1-100.8	105- 650	90-125	118-197
Center	258-490	1,300- 2,400	12.4- 78.5	115-1,300	85-132	102-202
Right	255-461	460- 4,900	12.2- 79.0	105-1,250	84-133	102-208
Station 3						
Left	290-522	42,000-79,000	19.5- 60.2	140-2,000	87-146	114-180
Center	262-464	670- 2,400	12.6- 44.3	150-1,600	85-152	105-174
Right	258-452	330- 3,300	12.4- 44.0	170-1,250	85-152	103-170
Section 4						
Left	258-502	4,900-11,000	16.2- 56.8	212-1,600	85-146	110-183
Center	270-490	5,130- 7,900	14.2- 46.5	246-1,875	85-144	105-183
Right	265-464	460- 2,400	12.6- 45.2	230-1,800	85-150	105-172
Station 5						
Left	275-476	4,400-13,000	14.4- 48.3	122-2,000	85-150	108-178
Center	270-471	670- 7,900	13.2- 46.8	155-1,700	84-148	105-170
Right	268-474	330- 790	13.2- 46.5	90-1,700	85-146	105-172
Station 6						
Left	270-475	5,000-13,000	13.4- 47.3	140-1,800	85-150	106-175
Center	270-475	2,800- 4,200	13.2- 47.3	135-1,700	85-148	105-170
Right	270-475	2,900- 5,400	13.4- 47.3	140-1,800	85,150	105-175

From time to time various other analyses are made for specific pollutants such as aluminum, iron, lead, manganese, copper, magnesium, sulfates, hexavalent chromate, phenol like compound and other organics.

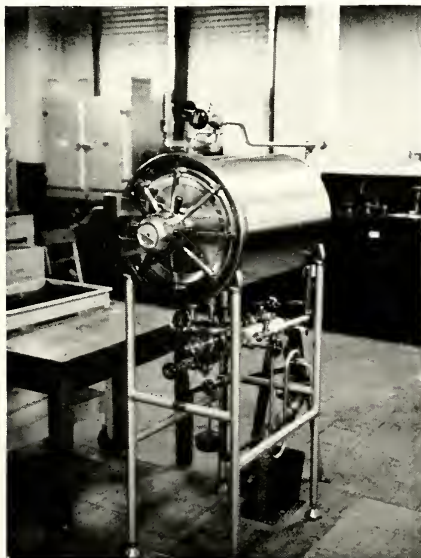
Initial biological sampling of the Mississippi River included plankton, benthos, and fishes. However, the sampling of plankton and fishes has now been eliminated for reason which will be discussed later and the sampling of benthos intensified. Through necessity of having objects from which to suspend traps or nets, the sampling locations for

collecting benthos and fish did not coincide with those for taking water and plankton samples. But the stations for collecting benthos and fish were located in such a manner as to determine the affects of the Baton Rouge complex on these forms of aquatic life.

Sampling revealed that the plankton of the river was rich in variety of species primarily rotifers and various life stages of copepods such as nauplius larvae, but rather poor in abundance of individuals. Moreover, the results were very erratic from station to station and from day to day at individual stations although some constancy was noted in seasonal variations. Upon consideration of the erratic results and with the knowledge that the passively floating freshwater plankton represented an element that would be transported to extinction in the Gulf within three to four days, it was deemed advisable to expend the time and effort on other portions of the aquatic fauna.

Hoop nets were utilized for collecting fish with the nets being located in such places as seemed most appropriate for determining the affects of industrial and municipal wastes. Resulting catches were too meager for reliable statistical analyses and consisted of rough fish and catfish. The catch below Baton Rouge was somewhat larger and would indicate that the scavengers were favored by addition of materials such as domestic sewage and spilled grains. However, this added production is off-set by a drop in eating quality of the fish. In fact, fishermen as far as fifty miles or more downstream complain of being unable to market their catches at times because of disagreeable oily odor and taste of the fish. The poor results obtained along with the repeated loss of rather expensive equipment by theft resulted in abandoning of this phase of biological analysis.

Attempts at sampling the benthos (bottom dwelling animals) with dredges were not satisfactory.



Sterilization of equipment for bacterial analysis is effected with a steam pressure chamber in which lethal temperatures and pressures can be maintained.

This led to the use of cages (Constructed of wire mesh and steel rods fastened to a concrete base and filled with sticks and moss) which, when lowered to the bottom, served to trap muds and act as an attachment medium for benthic organisms. Initial results obtained with the traps were good and indicated that some forms (e.g. amphipods) were reduced in numbers or eliminated by the industrial wastes. However, several difficulties were encountered among which were loss of traps through theft of the rope used to suspend them and difficulty of screening materials contained in the traps because of detritus from the moss. Many additional traps of lighter and cheaper construction were filled with sticks only and were made for use in continuing and expanding this phase of the survey. These traps suspended by very light swing chain, have been so located as to determine the affects wastes, current, depth of water and other factors might have on the benthos. It is the opinion of Division personnel that the benthos, being less subject to transportation by currents than the plankton and less capable of escape through their own locomotion than the fish, will yield the most satisfactory biological analysis of the affects of the Baton Rouge complex.

MISCELLANEOUS SURVEYS

In addition to its continuous and day to day activities, the Division has conducted during the past two years several brief but intensive surveys requiring the individual attention of two or more staff members for periods of a week or more. These surveys have been initiated through need for basic data in various drainages and fields of activity or through investigation of complaints posing such complexities that extensive investigations were necessary to obtain all pertinent information.

An intensive survey was conducted in the Norco-Destrehan area during May of 1958 to determine the affect of industrial discharges on the Bayou LaBranch and Bayou Trepagnier drainages between the Airline Highway and Lake Pontchartrain. Since the principal industries in the area are oil refineries, the most important analyses were determinations of the oil content of the waters and bottom muds. Oil content of the waters ranged from a high of 1457 ppm average for one station in the Airline Highway Canal near a refinery outfall to a low of 10 ppm average for the station least affected. Oil content of the bottom muds ranged from a high 650,000 ppm at a station in the Airline Highway Canal to a low of 382 ppm in Lake Pontchartrain 150 yards beyond the bar at the mouth of Bayou LaBranch. Among the other analyses conducted were determinations of biochemical oxygen demand and the most probable number of coliforms. These two analyses revealed the moderately heavy sewage contamination of the drainages. The heavy pollution of this area has resulted in a drastic reduction of both numbers and variety of aquatic life.

Additional checks on the Norco-Destrehan area have been made since the time of the initial survey to determine the validity of the data obtained during this short period. It was also hoped that checks following the closing of the Amoco Refinery at

Destrehan would give basic data on the recovery of areas grossly polluted with oil. However, loss of oils connected with dismantling of the refinery has somewhat defeated these hopes. However, most of the materials lost during dismantling have been heavy ends and have settled out rather rapidly. This has led to an increase in the oil content of the bottom muds in the upper part of Bayou LaBranch (from 340,000 ppm to 507,848 ppm or + 49.4%) and portions of the Airline Highway Canal (from 60,000 ppm to 78,660 ppm or + 31.1%). The lower part of Bayou LaBranch seems to be unaffected by the loss of these heavy ends of oil and indicates that the lesser the degree of pollution of the bottom muds the more rapid the recovery (from 98,000 ppm to 57,176 ppm or - 41.8%, from 24,000 ppm to 9,857 ppm or - 58.9%, and from 6,000 ppm to 661 ppm or - 89%).

Following complaints of fish-kills in the vicinity of Slidell, members of the Division staff ran a number of periodic checks on Bayou Bonfouca during June and July of 1958. Detailed water analyses were conducted on samples taken throughout the length of the bayou. In addition, a survey of the aquatic fauna was made. The water analyses indicated that the major source of trouble was the discharge of materials with high biochemical oxygen demand into a stream with little power for assimilating wastes, resulting in depletion of the dissolved oxygen. These materials represent discharge of both domestic sewage and industrial wastes. There is also considerable pollution from repeated loss of oil and oily materials by two industries. This is particularly noticeable as an accumulated contaminant of the bottom muds of the middle portion of the bayou. As one progresses from the headwaters of Bayou Bonfouca to its mouth at Lake Pontchartrain the picture of the aquatic life is as follows: the extreme headwaters, draining a rather barren pine area, have little in the way of aquatic flora and fauna; farther downstream there is an increase in numbers and variety of life concurrent with some enrichment of the waters from domestic sewage of scattered homes; immediately above and below Slidell in the area of gross pollution, aquatic life is absent; and below the area of gross pollution and extending to Lake Pontchartrain lies a zone of recovery with an increase in aquatic life.

The most recently initiated survey is one of statewide industrial water use. The state was divided into several regions and each region assigned to a group of the Division personnel. Attempts were made to contact every industrial installation within the state either by letter or by personal contact of some member of the staff. At present, information is available for slightly over 300 plants, which represents approximately 60 percent of those contacted.

Each installation was asked to furnish information as to the amount and source (city, wells, surface) of water used, the purpose (process, cooling, drinking and sanitary, etc.) for which it is used, and the amount of water discharged. As this information is received by the main office of the Division, it is being compiled on the basis of the type of industry (food processing, petroleum re-

finery, organic chemical, inorganic chemical, etc.), source, purpose, and geographic location by parish. It is the opinion of the Division that this information will prove invaluable in its future operations.

FISH - KILLS

During the past two years personnel of the Water Pollution Control Division have investigated numerous reports of fish-kills throughout the state. These kills occurred in all types of waters from farm ponds to major rivers and were attributable to many causes, both natural and man-made causes.

The majority of the kills were the results of natural causes with oxygen depletions being the foremost cause. Most of the natural oxygen depletions occur in the late spring and early summer and result from heavy blooms of algae. On sunny days these plants add oxygen to the water through photosynthesis, but at night and on cloudy days their respiration removes oxygen from the water and may result in complete depletion of dissolved oxygen. This type of oxygen depletion is common in farm ponds, borrow pits, and other bodies of standing waters where nutrients accumulate during the winter. Additional oxygen depletions resulted from high waters carrying heavy loads of leaves and other organic materials into bodies of water where the decomposition of these organics consumed all the oxygen. A third group of natural oxygen depletions occur in summer as a result of high water temperatures, low or no flow, and stagnation.

Several kills investigated were caused by oxygen depletions resulting from industrial discharges of materials with high biochemical oxygen demand. Most of these cases involved wastes discharged by food processing industries such as sweet potato canning or freezing plants, menhaden plants, slaughter houses and sugar mills. However, a few cases involved discharge of paper mill wastes and wastes or accidental spills from chemical plants.

The first hint of impending trouble in the Amelia area that the Division of Water Pollution Control had was a rumor in early June of 1958, that a menhaden plant was operating on Bayou Boeuf. With knowledge of the high organic content of wastes from menhaden plants and the low power of assimilation of streams such as Bayou Boeuf, it was deemed necessary to take immediate action. A waste Disposal Inspector was dispatched to the area and samples for biochemical oxygen demand analysis were received by the laboratory in Baton Rouge on June 9th. On June 11, the Division received a letter from the company giving some information on plant operations and stating that the discharge consisted of 4000 gallons per hour of pure water. This was in error as subsequent investigation revealed that the discharge was over 6000 gallons per minute of water highly charged with dissolved and suspended organics. On June 16 technical personnel from the laboratory visited the plant to secure additional samples and further information on operations. At this time the company was verbally informed that it was in violation of Stream Control Commission regulations and would be requested to appear at the next meeting of the Commission. It was also recom-

mended that the company immediately initiate plans for waste treatment facilities.

The initial fish-kills occurred in the area on June 22-23 and additional kills continued until late July. During this period several complete surveys were conducted in a section of Bayou Boeuf extending from the California Company Dock (approximately five miles northeast of the menhaden plant) to the Morgan City Locks (approximately 3 miles west of the plant). Analyses of samples taken during the surveys indicated that most chemical and physical characteristics of the waters were normal. However, profiling of the dissolved oxygen content and the biochemical oxygen demand revealed dissolved oxygen sags below a critical limit of 1.5 ppm, coinciding with increase of the biochemical oxygen demand from a base level of 4 ppm in Bayou Boeuf to a level of 10 ppm or more. These oxygen sags centered in the immediate vicinity of the menhaden plant (D.O.=0.0 and B.O.D.=1368 ppm) and extended for as much as 2 or 3 miles to the east or west depending on the direction of flow.

Following this period of repeated kills, the company took several emergency actions to eliminate discharge of most of the waste to Bayou Boeuf. In addition, general operation of the plant was more closely scrutinized and improved to upgrade the plant wastes. During this phase the Division laboratory performed numerous analyses on samples submitted by the company to determine the effectiveness of corrective measures. It is encouraging to note that no kills have been reported following these corrective measures.

Closely akin to oxygen depletion kills caused by industrial discharges, and at times concurrent with them, are kills involving discharges of toxic material. These may even be essentially non-toxic materials which by producing small but rapid changes in things such as pH, osmotic pressure, or temperature may prove fatal to fish. In addition, they may be toxic only when combined with substances already present in the body of water. Several kills from release by industry of toxic materials, including loss of drilling mud, ammonia, and nitrates, have been noted in the past two years.

Foremost among kills attributable to man-made causes have been those resulting from use of insecticides, primarily Endrin for control of cane borers and heptachlor for control of fire ants. These kills were caused by direct introduction of insecticides into the affected water bodies during careless aerial application and by insecticides borne by surface runoff from rains immediately following applications. Heptachlor has caused an occasional kill in the area affected by the fire ant control program, but the major cause of concern has been the widespread use of Endrin for control of cane borers throughout the cane growing area. During the 1958 growing season frequent kills caused by Endrin were reported, but during the 1959 growing season these kills reached alarming proportions with complaints being received by the Division of Water Pollution Control on an almost daily basis. In fact, many days brought complaints of kills in different watersheds over a several parish area. Recognizing the need for control of insects by

agricultural interests and at the same time the need for protection of our wildlife, Chief Biglane proposed to the Stream Control Commission a tentative set of regulations for control of aerial application of insecticides. These tentative regulations included issuance of permits and collection of permit fees for each application by some state agency, supervision of applications by inspectors, and prevention of application during times immediately proceeding rainfall or control of surface runoff from areas dusted.

A single fish-kill caused by a very heavy bloom of toxic algae was investigated by Division personnel. This kill took place in the summer of 1959 in an experimental fish rearing pond on the Louisiana State University Rice Experiment Station near Crowley. The causative agent was *Microcystis aeruginosa*, one of the blue-green algae which secrete toxic metabolic products. This is a freshwater counterpart of the famed marine red tide.

Cooperating with personnel of several other divisions, members of the Water Pollution Control staff investigated a widespread kill in the estuarine waters of the coast in the early winter of 1959. This kill was initially blamed on pollution, but careful investigation indicated that it was probably due to a sudden drop in water temperatures with the passage of a strong cold front. Similar kills have been noted in both fresh and marine waters.

BIOASSAYS

Biological assay tests using small fish and daphnids have been conducted for a number of substances received by the Division's laboratory from various sources. The purpose of these tests is to determine what concentrations of substances may be permitted in the waters of the state without harming the aquatic life.

Test animals are placed in tanks containing various concentrations of the substance being tested and the mortality noted at standard intervals of time, generally 24, 48, and 96 hours. That concentration at which half the test animals die in a given period of time is the median toleration limit for that interval of time. The limit of concentration allowable in waters is usually ten percent of the appropriate median toleration limit. By knowing the volume of the flow of the receiving stream and the median toleration limit, we can determine how much of a substance an industry may be permitted to discharge. As examples of practical application of knowledge obtained through bioassays, let us take the cases of three of the materials tested, Algalrol, Endrin, and Bit Lube.

Algalrol is a quarternary ammonia compound used for control of algal growth in cooling systems. The recommended concentration for use in cooling systems is 60 parts per million. Bioassay tests on small bluegills indicated that the 48 hour median toleration limit is over 200 ppm. Thus the dis-

charge from cooling systems using Algalrol is safe even without any dilution factor in the receiving water.

Bioassay tests of Endrin revealed a 24 hour median toleration limit of 1.0 ppm active ingredient and a 48 hour median toleration limit of 0.25 ppm, for small bluegills. Endrin is applied in dusting cane in the amount of $\frac{1}{4}$ lb./acre of active ingredient as $12\frac{1}{2}$ lbs./acre of 2 percent dust. Four such applications are made at two-week intervals. The period for degeneration of activity of Endrin is 60 days so there is some accumulation for each dusting. Figuring an allowable concentration of 10 percent of the 48 hour median toleration limit (0.025 ppm), an accidental dusting of a body of water averaging six feet deep would give a concentration of 60 percent of the allowable or 0.015 ppm. A body of water averaging four feet deep would receive a dosage equal to the maximum allowable concentration in a single accidental dusting. However, surface runoff is a much more potent threat and seems to be the major cause of fish-kills. Assuming that a two inch rainfall following the second dusting removes 50 percent of the available Endrin and assuming a 50 percent residual to be present from the first dusting, the surface runoff would contain 0.826 ppm of Endrin and must undergo a 3 to 1 dilution in the receiving waters to avoid exceeding the maximum allowable. When one considers the many acres of cane that are dusted in relation to the much smaller number of acres of receiving waters, there is little reason to wonder that we have had many fish-kills following rainfall in the cane growing parishes.

Bit Lube is a drilling mud additive produced by Magcobar. The Division received several requests for permission from drilling operators desiring to dump muds containing four to eight pounds (approximately $\frac{1}{2}$ to 1 gallon) per barrel (31.5 gallons) of Bit Lube. They had been informed by the manufacturer that the muds containing Bit Lube were non-toxic and not oil base muds and that spent muds could be dumped without causing any damage. Bioassay tests for Bit Lube conducted with small bluegills revealed the median toleration limits to be as follows: 24 hours, 60 ppm; 48 hours, 17.5 ppm; 72 hours, 14 ppm; and 96 hours, 10 ppm. Tests conducted with daphnids showed that Bit Lube was even more toxic to these organisms than it was to the bluegills. The median toleration limits for the longer periods of time are highly significant as combined with the other ingredients, the Bit Lube would slowly leach out of the mud and would contaminate the surrounding area for extended periods. In addition, the drilling muds are widely used in the coastal areas where production of seafoods is important and there is little flow to carry away contaminated water, or increase dilution. Needless to say, permission to dump drilling muds containing Bit Lube was not granted.





